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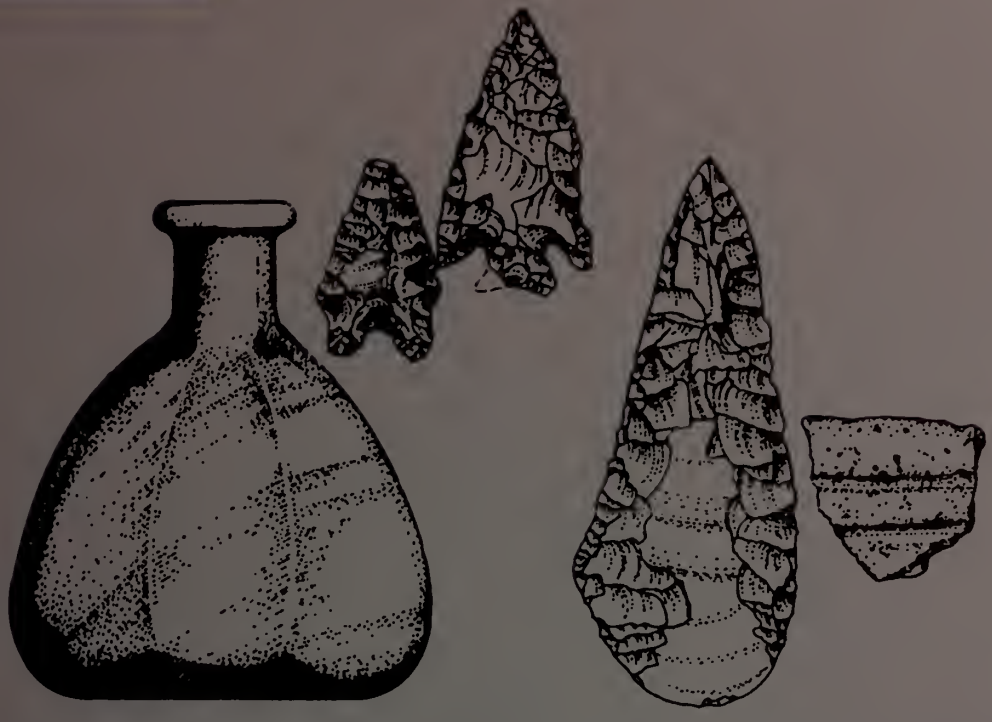

AN ARCHAEOLOGICAL SURVEY AND PREDICTIVE MODEL OF SELECTED AREAS OF UTAH'S CISCO DESERT

John E. Bradley, William R. Killam, George R. Burns, and Marilyn A, Martorano

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John E. Bradley, William R. Killam, George R. Burns, and Marilyn A. Martorano

Under the Direction
of
William R. Killam, P.I.
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The Cisco III investigations reported herein are the logical continuation of those included in Volume 5 of this series. Both volumes report on sample-oriented surveys of public land in portions of the Cisco Desert in Grand County Utah, Moab District. Originally thought to be an extremely low site density area, this current volume reports areas of high (over 25 sites per square mile) site density. Because of this unexpected plethora of sites, the survey sample of 80,000 acres was reduced ftom 10% to 5% after the first fieldwork session.

This report used the statistical procedures and environmental factors presented in Volume 11 of this series to build a preliminary predictive model based on existing data from Volume 5. The results of this study, however, indicate the use of soil maps is simpler and more accurate for predicting areas of relative site densities in the Cisco Desert.

In addition to providing a simplified management tool for over 220,000 acres of public land, this volume presents an expanded view of prehistoric utilization of a marginal environment. This volume, therefore, should prove useful to Federal land managers and cultural resource investigators alike.

Richard E. Fike, Series Editor

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ABSTRACT

A sample-oriented cultural resources survey of 80,000 acres in Grand County, east-central Utah, was undertaken and a predictive model was constructed using previously collected data. Fieldwork was conducted in 1983 by Goodson & Associates, Inc. of Lakewood, Colorado, under contract with the Bureau of Land Management. Initially a 10% unstratified random sampling strategy was devised, with the collected data to be used in testing the model. Upon initiation of the fieldwork, it was discovered that site density was much higher than anticipated, based on frequencies reported in the previously surveyed study tracts. Consequently, the sample fraction was reduced to 5%. Data collected from 100 40-acre transects were used to construct a predictive model. An additional 17 transects were surveyed as an independent sample and the resultant data, as well as other information, were used to test the model. A total of 126 sites was recorded with 88 sites used in model construction. Site densities ranged from three to twelve times higher, depending on the sensitivity zone, than was indicated by previous survey.

Several models were constructed using discriminant analysis. Classification accuracy consistently ranged above 80%. In addition to the traditional environmental variables analysis, soil groups were successfully used to discriminate between site and nonsite loci. Relationships among the traditional environmental variables and soil groups were demonstrated, and site sensitivity zones were developed using the soil models. Future research directions are recommended.

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CHAPTER I

INTRODUCTION

This project was conceived as the logical continuation of cultural resources investigations in the Cisco Desert of Grand County, east-central Utah (Figure 1). Aside from numerous small, energy-related surveys, two major surveys were undertaken in 1978 and 1979 by Nickens and Associates, Inc. of Montrose, Colorado. These consisted of Class II random stratified surveys at a 10% sampling fraction totaling approximately 145,000 acres (Figure 2) (Reed and Nickens 1980). The latest effort, Cisco III, was originally designed to continue the 10% random stratified sampling of an additional 80,000 acres in the intermediate and adjacent areas, resulting in a total sampling universe of 225,000 acres of federally-administered land.

Accurate determination of the Cisco Desert vegetation "strata" had been problematical in 1978 and 1979, and it was agreed that a simple random sample would be more appropriate with the vegetation boundaries identified during the survey. The presence of sand dune sites near Cottonwood Wash in the Cisco III study area found subsequent to the 1978 and 1979 fieldwork (Babcock 1981) also supported a sampling scheme unrestricted by general vegetation stratification. The work of Larralde and Chandler (1981) in the Uinta Basin, demonstrating the unique vegetative nature and associated difficulties in defining sand dune localities, further supported a simple random sample, as opposed to proportionally stratified, sampling scheme.

The contract required that a predictive model of prehistoric site and nonsite locations be constructed prior to fieldwork using previously collected data. The Cisco III field survey results would then be an independent test of both the model and the hypotheses generated by the previous work of Nickens and Associates, Inc. The model would have a predictive accuracy of at least 80% for both site and nonsite locations, or if not, it would be refined using the Cisco III survey data and be further tested with independent data. Site density and sensitivity maps generated from the model would be constructed reflecting probabilities of site and nonsite occurrence for use by BLM resource managers.

The original model was constructed from 38 prehistoric site locations and 57 randomly sampled nonsite transects encountered during Nickens and Associates, Inc. 1978 and 1979 fieldwork. Following previously successful modeling attempts by Holmer (1979), Burgess et al. (1980), Larralde and Chandler (1981) and Kvamme (1982) of somewhat similar environmental conditions, 16 environmental variables were encoded for each prehistoric site and nonsite location. Classification accuracy of 87% for prehistoric sites and 83% for nonsites at the .05 confidence level was obtained.

During early stages of the fieldwork, it became apparent the model would be inadequate in discriminating between sites and nonsites in the Cisco III project area. After only 2% of the project area had been sampled (1600 acres), 49 sites were recorded using site definitions identical to those of the previous surveys. This was nearly as many as the total number of sites previously recorded (53) in the 1978 and 1979 surveys of 14,080 acres. Many of the sites encountered in the Cisco III survey were located

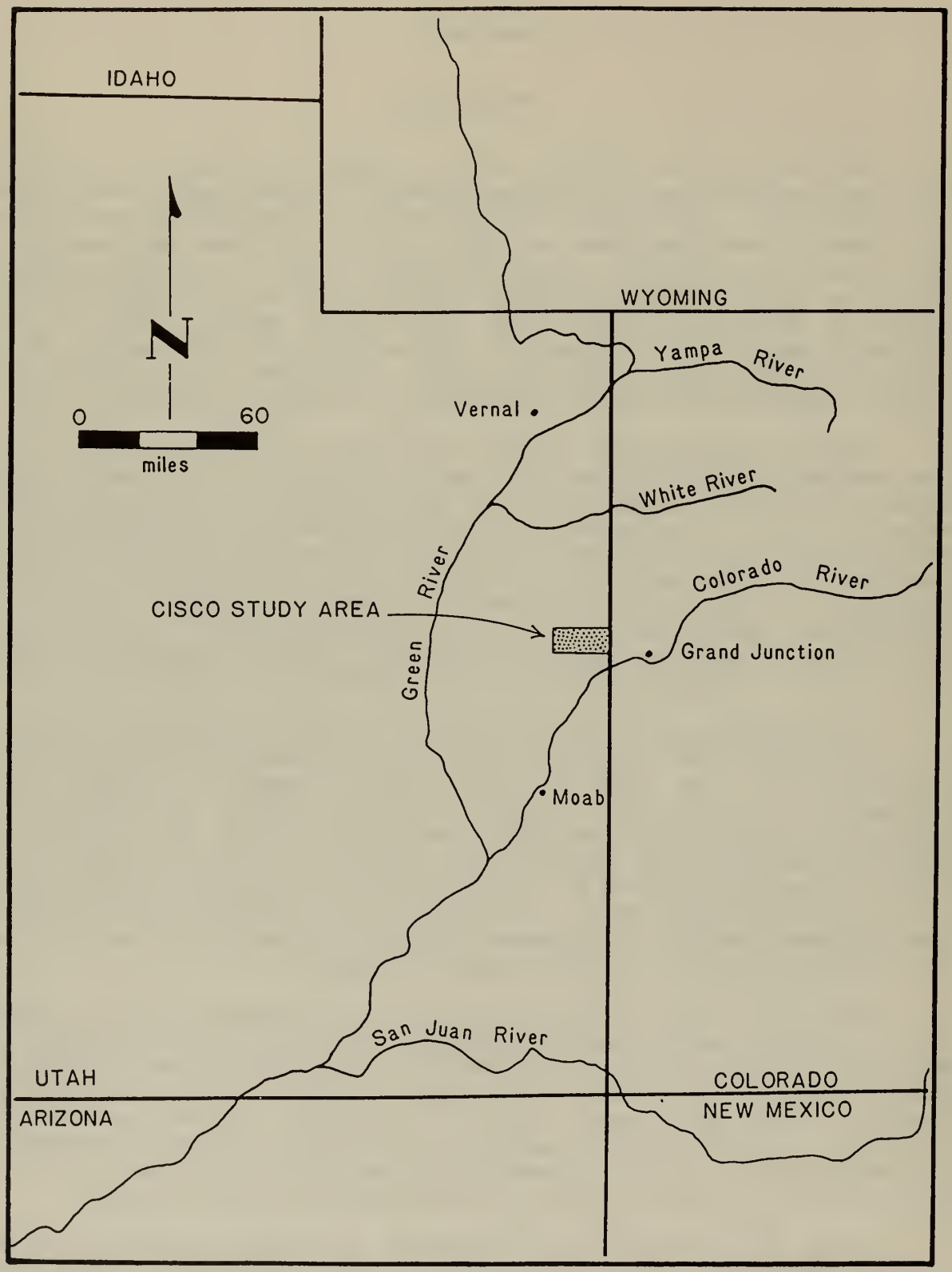


FIGURE 1. Location of Cisco Cultural Resources Study Area (After Nickens 1980).

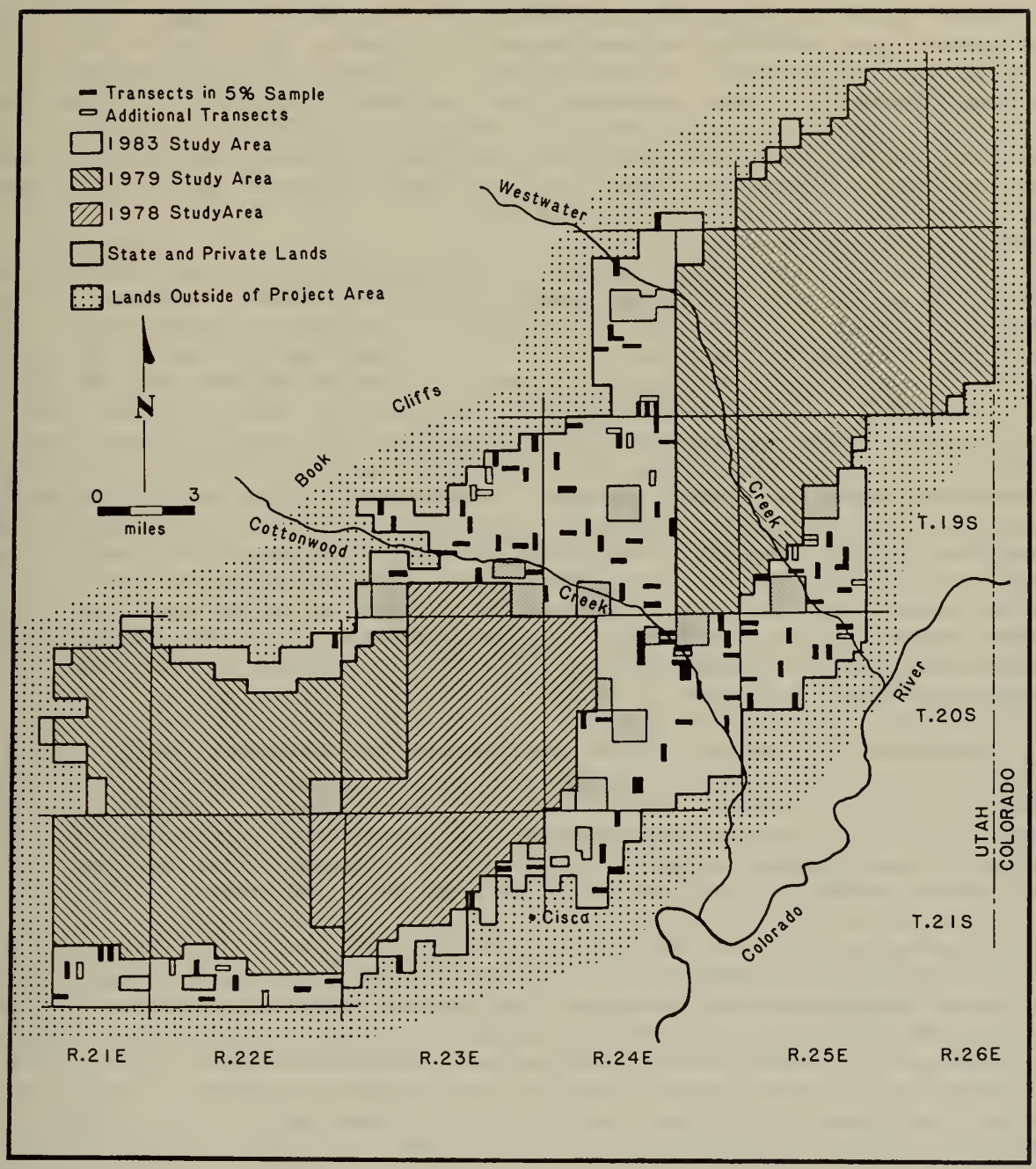


FIGURE 2. Cisco Project Area Boundaries and 1983 Transect Locations.

in microenvironmental zones that were not present in the previous areas, e.g., sand and silt dunes and rockshelters. Whereas the previous work indicated site density would range from a low of 0.38 to a high of 9.6 sites per square mile depending on environmental stratum, the initial Cisco III data average was over 19 sites per square mile, or 8 times the overall site density figure for the combined 1978 and 1979 fieldwork. Predictive accuracy of the model verified what was obvious; only 15% of the prehistoric sites were accurately predicted. Nonsite prediction accuracy, however, was high at 92%, and indicated the low site density desert shrub areas were similar to those surveyed in 1978 and 1979.

Due to the substantial increase in site density, it was necessary to refine the model to account for the higher density areas. Because of the potential number of sites to be recorded and budgetary restrictions, the sampling fraction was reduced to 5%; 4,000 acres rather than 8,000 acres would be intensively surveyed. However, the 5% sample of the more environmentally diverse area obviously could not be used to test a model built on the more environmentally homogeneous 1978 and 1979 field data. Information on the environmental variables from the sites and nonsites within the Cisco III study area would have to be entered into a new model that would ideally predict site and nonsite locations for the entire 225,000 acre Cisco Desert region. The change in sample fraction and sample size also precluded the use of the previous data in building the new model. The "5% solution", as it came to be known, would be to build the model on the 5% survey data from the 1983 field season and then test the model on the independent data collected during the previous surveys rather than vice versa as originally planned.

Contract No. YA-553-CT2-138 was executed in September, 1982, after a modified proposal had been accepted by the BLM contracting officer, Ronald Corsi. Bruce Louthan, Moab District Archaeologist, served as the Contracting Officer's Representative and main point of contact. The principal investigator's responsibilities for Goodson & Associates, Inc. were shared jointly by William R. Killam and John E. Bradley.

The stated purposes of the contract were to provide data for project area planning and environmental analysis, to collect cultural resources data to further define cultural processes and the nature of the resources, and to provide recommendations for future research needs and directions. The BLM is mandated by Federal legislation to identify, evaluate and protect cultural resources on public lands under its administration. These laws include the Reservoir Salvage Act of 1960, as amended by P.L. 93-291; the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969; the Federal Land Policy and Management Act of 1976 and Executive Order 11593. Interest in the Cisco area was precipitated by the then increasing amount of energy-related exploration and development, and concurrent requirements for surveys prior to land-disturbing activities. This project was seen as a possible way to decrease the need for survey in areas where probability of encountering significant resources are low, and can be predicted with a high level of confidence.

In working toward the general objective of generating cultural resources data for area-wide planning, several specific objectives were met. Recorded data from 126 sites allowed refinement of the cultural history of

the Cisco area and redefinition of the extent and location of human use of the region. As part of the analysis, National Register criteria (36 CFR 60.4) were applied and eligibility recommendations and mitigative measures were offered for each site. Using multivariate discriminant analysis,a predictive model for site and nonsite locations was built using the 10% data collected by the previous Class II surveys in the Cisco Desert. Depending on a number of factors, this model yielded a range of classification accuracy percentages, all above the required 80%. Two additional models, constructed using the 1983 field season 5% data, produced classification accuracy rates of over 80% for both site and nonsite locations. Predictive accuracy over 80% was obtained only for the model based on soils variables. This has led to a different understanding of prehistoric land use patterns for the area than previously hypothesized.

SURVEY STRATEGY AND METHODOLOGY

As described above, the original terms of this contract required the survey of a 10% random sample of 80,000 acres using 40-acre (1/2 mile by 1/8 mile) transects, i.e., 200 transects. However, the project maps supplied by the BLM included more than 80,000 acres. To make the actual project area conform with the contract requirements (since the contract could not be modified at that time), several thousand acres of land were dropped from consideration. In an attempt to reduce bias, areas of very steep relief along the Book Cliffs were eliminated and only BLM lands in quarter section increments were included. Three sections in the extreme northeast corner of the project area along the state line were also dropped, as this area was not included on the original map in the Request for Proposals (RFP). This method allowed elimination of areas with differing environmental characteristics, rather than in one locality only.

Once the sample universe of 80,000 acres was defined, a simple random sample method of transect selection was chosen rather than random stratification based on environmental zones, due to problems previously encountered using environmental strata. Additionally, the selection was a simple random sample rather than a systematic random sample used previously, i.e., areas were not excluded because of lack of cadastral markers. Each section or quarter section was divided into 40-acre transects as shown in Figure 3, and each transect was assigned a consecutive number from 1 to 4,000. These numbers were then printed in a random order by an Osborne-1 microcomputer. The first 200 transects that did not overlap were selected for survey. For example, the first transect selected was 41-13, a north-south transect in the W1/4 of the SE1/4 of Section 29, T.21S., R.23E. (Figure 3). The number 41 designates the section and 13 the transect location within the section.

Because the eventual halving of the sample size was not anticipated, transects were surveyed in non-ordered and non-random fashion. However, an attempt was made early in the project to examine transects located in different environmental zones. After the first full-crew field session, 40 transects (1600 acres) had been surveyed and 49 sites recorded within these transects. Because the concept and requirements of the contract were predicated on an assumed low site density, it was apparent that changes were in order. After exploring many possibilities, it was decided to keep the

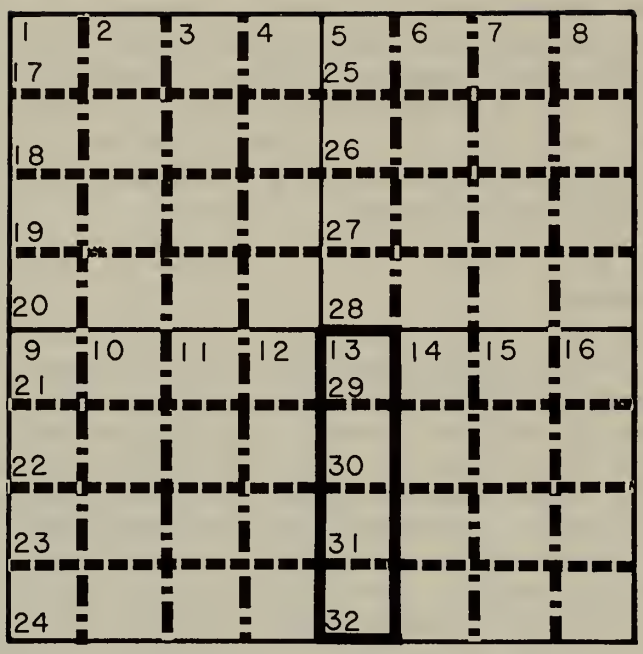


FIGURE 3. First Transect Selected.

project area the same size and reduce the sample to 5%. Only the first 100 transects of the original 200 randomly selected transects would be used to build the new model. Of the 40 transects surveyed during the first field session, 23 were in the first randomly selected 100 transects. Site and nonsite data from the other 17 transects could not be used during model building, however, they could be used as additional independent test cases. Along with the site and nonsite information from the previously surveyed areas, these transects would be used to test the model's predictive accuracy.

Field survey commenced on May 26, 1983, with the co-principal investigators serving as crew chiefs. The crew consisted of George Burns, Jim Miller, Steve Dominguez and Robert Johnson. Because of the site density problem, there was a survey hiatus between June 17 and July 19. When the fieldwork resumed, George Burns and John Bradley served as crew chiefs. The crew remained the same, with the addition of Julie Crisp. Unpaid individuals who assisted with the fieldwork for varying lengths of time included Roberta Klausing-Bradley, Bruce Louthan, Norma Broten and Cora Smyth. Dr. Charles Bonham, project statistician, visited the project area, as well as piloted an over-flight of the region with the principal investigators. Dave Hansen, BLM soil scientist, also visited the project area and helped with the soil interpretations. Except for a brief visit, fieldwork ended on August 16, 1983. The crew camped on BLM land within the project area during the survey.

Standard field procedures utilized two three-person crews, however, crew size ranged from two to six persons. Transects were located using topographic maps, cadastral monuments and triangulating from prominent natural features. Because section and quarter section corners were not included in many of the transects, pacing was important for locating and determining transect length and width. At least two persons kept count of the pace, and each crewperson soon figured out his/her pace/distance count. Although cadastral monuments often were not present on the transects selected, those near transects were located and used to pace off distances to the transects and to double check the location on return without undue difficulty or wasted time. Once located, transects were surveyed with two to four parallel crew sweeps, with personnel spaced no more than 15 meters (49 feet) apart. The ends of the transects and the inside lines were temporarily flagged with orange pin flags. When resources were encountered, the sweeps were halted and flagged, and personnel fanned out to define the resource boundaries. Once defined, the site (or isolated find) was usually recorded immediately. There were times, however, when a six-person crew was utilized in the high site density areas along Cottonwood Wash, that the sites were flagged, located on the topographic map and recorded at a later date by a smaller crew. This procedure, used judiciously, increased both survey and recording efficiency and enabled the rechecking of site and transect locations.

To maintain consistency with the previous work, prehistoric sites were defined as containing five or more artifacts within a reasonable area, or a feature and one or more artifacts. If an artifact, or cluster of artifacts, was located more than approximately 25 meters (82 feet) from the originally discovered site, it was usually recorded separately and its association with other sites noted. Again, in the high site density areas along Cottonwood

Wash, this rule of thumb was occasionally overlooked and site boundaries stretched somewhat depending on the similarity of artifactual material and the micro-environment. Historic site definitions were similar, with recent trash scatters (less than 50 years old) not being recorded as sites. Diagnostic prehistoric artifacts were collected, as was obsidian and chert source material. Diagnostic historic artifacts were drawn and described in the field or collected. In addition to all standard site forms and maps, a transect form (from Larralde and Chandler 1981) was completed for each surveyed transect indicating topography, hydrology and vegetation zones.

DATA ANALYSIS AND REPORT PREPARATION

The multivariate discriminant analysis computer program was implemented by Dr. Charles Bonham of Colorado State University (CSU) and his research associate, Dr. Mario Biondini, using the SPSS program (Nie et al. 1975). Employing non-archaeologist statisticians proved very beneficial as they had no preconceived notions as to man's activity patterns, and made judgments and decisions on a strictly mathematical basis. Programs were keypunched by the CSU data processing division and all major calculations were run on the CSU Gold Computer Program. Other programs were run in-house on an Osborne-1 microcomputer.

The results of the computer runs and statistical manipulations were analyzed by John Bradley and Dr. Charles Bonham. Dave Hansen, soil scientist for the BLM Moab District, provided valuable data on the soils within the project area and assisted with the interpretation. Prehistoric lithic artifacts were analyzed by George Burns. The ceramics were identified by Calvin Jennings of CSU and Priscilla Ellwood of the University of Colorado Museum and historic artifacts analyzed by Marilyn Martorano and William Killam. Glass beads were examined and identified by Richard Conn of the Denver Art Museum. Coding of variables for site and nonsite data was accomplished by John Bradley, Marilyn Martorano, George Burns, Jim Miller, Roberta Klausing-Bradley and William Killam. Artifact drawings were rendered by Steve Dominguez, site maps by George Burns and Julie Crisp, the geologic and soils cross section by George Burns, and all other report maps by Steve Dominguez. Word processing and report reproduction duties were handled by Jacqueline Anderson, Ellen Cobb, Brenda Trost and Roberta Klausing-Bradley.

For this publication, the report was edited by Marilyn Martorano, William Killam and John Bradley. Word processing and reformating was done by Beverly Breda and Kimberly Forsyth. Goodson & Associates, Inc. contributed the materials, operators' salary and use of the word processing equipment.

The report was orginally submitted to the BLM in August, 1984, as the final contract deliverable. At that time it included eight additional appendices, including site forms, computer printouts and artifact catalogs. This information is available to the interested reader at the BLM Moab District Office. Finally, due to time and budget restrictions, there has been no attempt to consider any reports written since the original submission in 1984.

CHAPTER II

ENVIRONMENTAL OVERVIEW

LOCATION

The 80,000 acre Cisco III Cultural Resource Study Area is located in east-central Grand County, Utah, in the east half of the BLM Book Mountain Planning Unit, Moab District (Figure 1). The area is bounded on the north by the first terrace of the Book Cliffs, on the east by the Colorado-Utah border, the south by an arbitrary line about five miles north of the Colorado River and on the west by an arbitrary line approximately ten miles east of Thompson, Utah (Figure 2). The nearest town is Cisco, Utah, located approximately two miles south of the project area. The nearest major population is Grand Junction, Colorado, situated approximately 30 miles east of the project area. Interstate 70 is the main thoroughfare through the area and U.S. Highway 6/50 provides secondary access. Access to various sections of the project area is via several graveled and unimproved ranch or railroad service roads.

GEOMORPHOLOGY

The project area lies in the northern portion of the Canyonlands section of the Colorado Plateau Physiographic Province (Murphy 1981:17). Figure 4 depicts the geologic and soils cross section illustrated in Figure 5. As detailed in the latter figure, several Mesa Verde group sandstone and shale strata (ca. 70 million years old) dip in a general northwest direction on the northwest side of the area, forming the Book Cliffs (Cashion 1973; Barnes 1978). Forming the southern margin of the Tavaputs Plateau, the Book Cliffs attain a maximum elevation of about 10,000 feet, and descend in large escarpments to about 5,200 feet in the project area (Figure 5). The cliffs drop to the relatively flat Mancos Shale lowlands of the Cisco Desert, lying at about 4,500 feet. Below the upper Cretaceous age (ca. 100 million years old) shale deposits of the desert lie the color-banded strata of the Jurassic (ca. 150 million years old) shales and sandstones of the Summerville and Morrison Formations, lying at an elevation of about 4,700 feet.

HYDROLOGY

Drainages in the project area include Cottonwood, Cisco, Nash, Danish, Sagers and Pinto Washes, and Westwater, Sulphur and Bitter Creeks, flowing in a general southeasterly direction from the Book Cliffs to the Colorado River. Most are intermittent or ephemeral in nature, with more water in their northern reaches, when any is present at all, and which is often absorbed or flows underground at some point in the desert. Cottonwood Wash (Figures 6 and 7) is the largest drainage in the area, draining a wide area of the Book Cliffs and is fed by numerous springs. It maintained a steady flow of water at all points observed during the course of fieldwork. Westwater Creek (Figure 8) was also flowing along most of its extent across

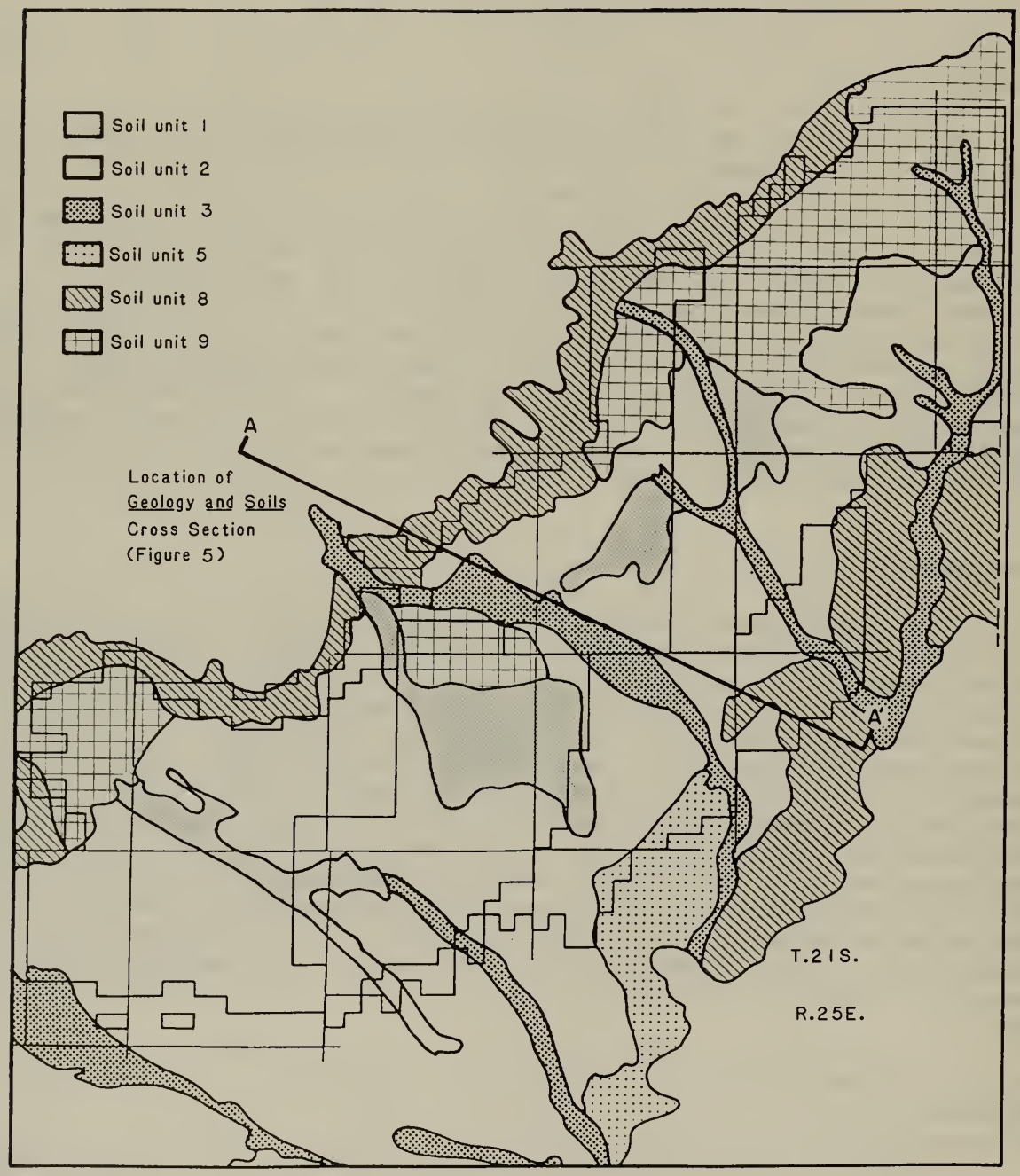


FIGURE 4. Location of Geology and Soils Cross Section and General Soil Units in the Cisco Area.

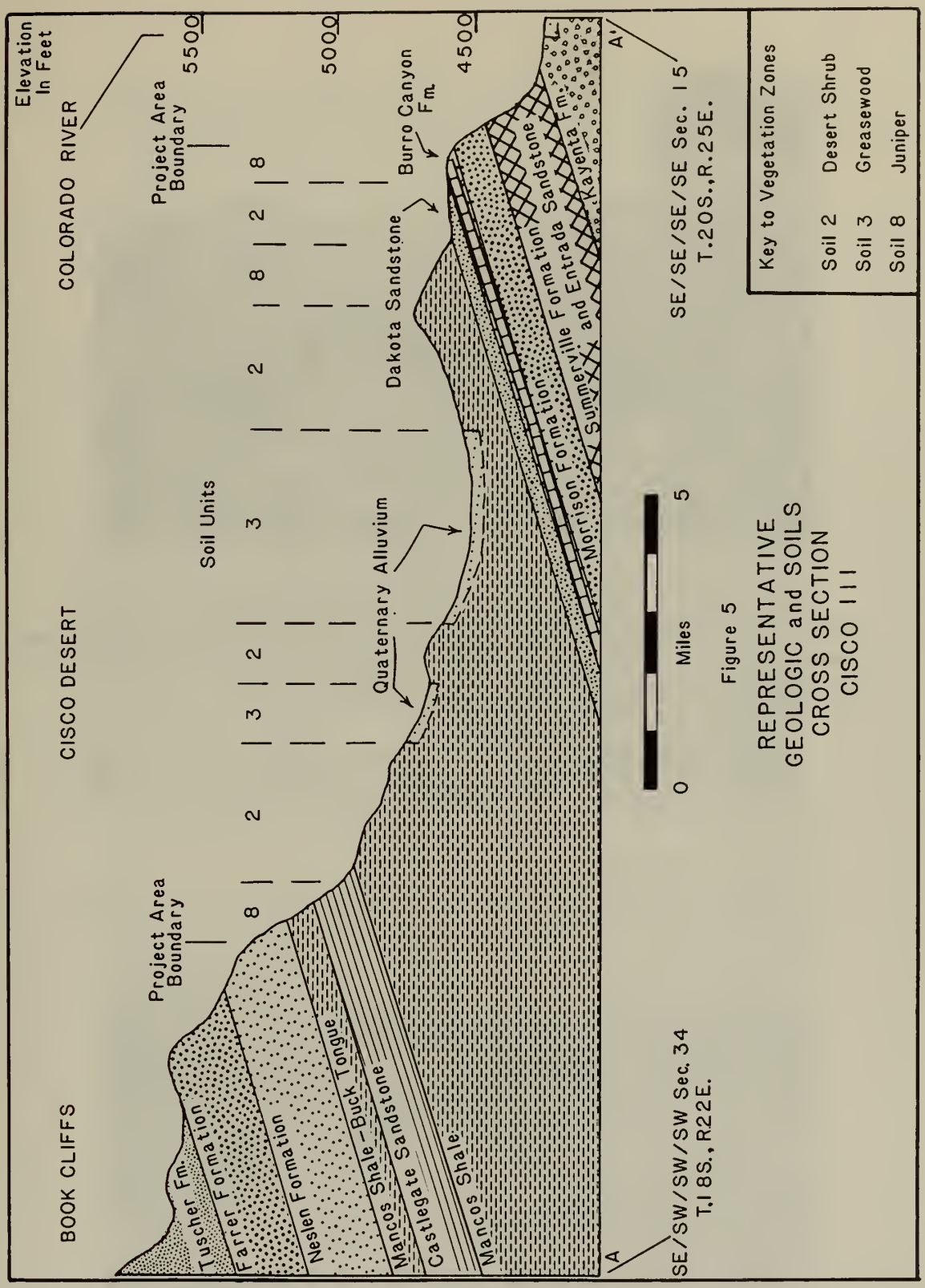


FIGURE 5. Representative Geologic and Soil Cross Section, Cisco III.

FIGURE 6. View of the head of Cottonwood Wash at the base of the Book Cliffs, looking northwest from the north rim of Cottonwood Canyon near site 42GR1659.

FIGURE 7. Cottonwood Wash looking south from the lower terrace of the Book Cliffs.

FIGURE 8. Westwater Creek looking north from Site 42GR1715.

the desert, alternately going subsurface then resurfacing at several points as it approached the Colorado River. Much of its water is presently being diverted to irrigate vineyards near the Book Cliffs. No other drainages were observed to contain water during the time of fieldwork.

SOILS

The term "soil" has various definitions utilized by geologists, agriculturalists and engineers. A good general description is found in Peter W. Birkeland (1974:3) and is: "soil is a natural body consisting of layers or horizons of mineral and/or organic constituents of variable thicknesses, which differ from the parent material in their morphological, physical, chemical, and mineralogical properties and their biological characteristics". Most surface soil deposits are sediments weathered from bedrock in one area and transported by water, wind or ice to another area. Geologists have classified such deposits according to the mode of transportation by which they were carried to the place of deposition, i.e., alluvium, dunes and loess, till or glacial drift and colluvium. Untransported soils are termed sedimentary deposits and those formed in situ as result of weathering are called residual deposits (Hunt 1972:3, 4).

Soils within the project area were specifically classified during a soil survey of the central part of Grand County (Soil Survey of Grand County, Central Part, Utah, 1982). This survey was accomplished through the joint efforts of soil scientists and range specialists utilizing information on soils, geology, climate, vegetation, landforms and patterns of land use. The result of the survey was the delineation of 12 general soil units, each of which embody a distinctive pattern of soils, relief and drainage. Within the 12 major units are major and minor soil types which have been delineated by field symbols on acetate USGS map overlays. The 12 general soil units are mapped in Appendix 1A and the major soil components and general descriptions are listed in Appendix 1B.

The general soils actually occurring in the study area are units 1, 2, 3, 5, 8 and 9 (Figure 4). General soil unit 1 contains taxonomic units Mesa, Mack and Chipeta and consists of loamy soils on alluvial fan pediments and shale plains associated with minor and ephemeral drainages. Unit 2, containing taxonomic units Chipeta, Killpack and Blueflat, consists of clayey soils on shale plains, pediments, cuestas and ridges associated with lowlands between drainages. Major soil unit 3 contains the units Toddler, Ravola and Glenton and consists of loamy soils located on fans, flood plains and along drainages (Cisco Wash, Sagers Wash, Cottonwood Wash, and Westwater, Sulphur and Bitter Creeks). Unit 5 consists of loamy soils located on cuestas, benches, valley sideslopes and rock outcrops, contains taxonomic units Moenkopie, Nakai and Rock Outcrop, and is characterized by Morrison and Burro Canyon formations of the Colorado River cliffs. Unit 8 contains taxonomic units Shalako, dry-Thedalund and stony-Hanksville, and consists of loamy and stony soils found on benches, cuestas, alluvial fans and canyon escarpments immediately below the Book Cliffs and just above the Colorado River. Soil unit 9 contains taxonomic units Barx, Strych and Sandoval and consists of loamy soils located primarily on alluvial fans and fan pediments below the Book Cliffs.

Soils of the area reflect the underlying geology and, in large part, determine or limit the present and past vegetation communities. The soils are generally dry, warm and deep, Aridisols or Entisols, or more specifically, Haplargids, Calciorthids, Torriothents and Torrifluvents (Upper Colorado Region Inter-Agency Group 1971:23; Hutchings and Murphy 1981:29). The soils are alkaline in character and often contain an horizon high in calcium at some depth. Without irrigation, areas dominated by these soils are of little use except for limited grazing and wildlife (Hutchings and Murphy 1981:29). Surficially richer, more recent alluvial deposits occur along Cottonwood Wash and Westwater Creek (Cashion 1973) and a more humic (carbonaceous) loess may be found bounding the desert near the base of and atop the first terrace of the Book Cliffs.

VEGETATION

Vegetation of the study area may be divided into major zones, related, in large part, to soil type, elevation and topographic situation (Figure 5). The Aridisols of the Mancos Shale Lowlands are conducive to the growth of shadscale, saltbush, big sage and other low, hearty, desert shrub plants (Figure 9). Grasses (Figure 10) occur in varying amounts, from less than 5% in the desert shrub, to almost total domination in "The Grassies" near Danish Flat, where loess soils prevail. The alluvial deposits along the larger drainages support a more lush tamarisk and greasewood community (Figure 11). These "greasewood belts" of Cottonwood Wash and Westwater Creek are especially prominent features when viewed from the uplands bounding the desert or from the air. The uplands are predominated by juniper woodlands (Figure 12) with scattered pinyon pines on some mesa tops in the Book Cliffs. Historic impact, sheep overgrazing in particular, has altered much of the native rangeland and resulted in the secondary appearance of cheatgrass brome, which now dominates much of the area.

Edible plant species are abundant in some areas during their seasonal appearance. Sego lilies, with their edible roots, appear during May and June, and Indian rice grass, widespread in July and August, provide easily collectible foodstuffs (Larralde and Chandler 1981:97). Plains pricklypear is available during all summer months, as are cattail, both providing viable food sources. These are but a few of the edible species present, but serve to demonstrate that transhumance could easily be effected in the area at certain times of year. Table 1 provides a list of vegetation observed in the project area.

CLIMATE

Most of the study area is in an arid desert environment where annual precipitation, averaging six to eight inches, is less than half of the potential evaporation. Sagebrush and a variety of desert shrub plants thrive in this area. The northern portion of the area lies in the steppelands, the semi-arid transitional zone between the desert and the higher mountainous areas. Averaging eight to ten inches of precipitation annually, the steppelands are conducive to the growth of short grasses, juniper and some pine and oak (Wormington 1955:4; Richardson et al. 1981c:67). May and June typically receive the least amount of precipitation

FIGURE 9. Mat saltbush vegetation at site 43GR1677, looking east.

FIGURE 10. Grass vegetation zone, looking north toward the Book Cliffs.

FIGURE 11. Greasewood vegetation at site 42GR1628, looking southwest.

FIGURE 12. Uplands vegetation zone dominated by juniper woodlands, looking northwest toward the Book Cliffs.

while August through October have the most (Reed and Nickens 1980:18). An average of ten to twenty inches of snow falls annually (Richardson et al. 1981d:70).

TABLE 1. Vegetation Observed in Project Area.

Common Name	Latin Name
Bulrush	Scirpus sp.
Rush	Juncus sp.
Salina Wildrye	Elymus salinus
Indian Rice Grass	Oryzopsis hymenoides
Scarlet Globemallow	Sphaeralcea coccinea
Utah Serviceberry	Amelanchier utahensis
Cliffrose	Cowania stansburiana
Utah Juniper	Juniperus utahensis
Pinyon Pine	Pinus edulis
Mountain Mahogany	Cercocarpus montanum
Sunflower	Helianthus annuus
Winter-fat	Eurotia lanata
Big Sagebrush	Artemesia tridentata tridentata
Wyoming Big Sagebrush	Artemesia tridentata wyomingensis
Mat Saltbush	Atriplex corrugata
Four-wing Saltbush	Atriplex canescens
Shadscale	Atriplex confertifolia
Nuttall Saltbush	Atriplex nuttallii
Rabbitbrush	Chrysothamnus sp.
Greasewood	Sarcobatus vermiculatus
Fremont Barberry	Berberis fremontii
Blackbrush	Coleogyne ramosissima
Tamarisk	Tamarix pentandra
Plains Pricklypear	Opunitia polyacantha
Cheatgrass Brome	Bromus tectorum
Tansy Mustard	Descurainia sophia
Broom Snakeweed	Gutierrezia sarothrae
Single Leaf Ash	Fraxinus anomala
Gambel Oak	Quercus gambelii
Narrowleaf Yucca	Yucca angustissima
Bitterbrush	Purshia tridentata
Common Cottonwood	Populus fremontii
Mormon Tea	Ephedra viridis
Spineless Hopsage	Grayia brandegei
Sego Lily	Calochortus gunnisonii
Jimsonweed	Datura meteloides
Miner's Lettuce	Montia perfoliata
Prickly Lettuce	Lactuca serriola
Russian Thistle	Salsola kali
Blue Grama	Bouteloua gracilis
Crested Wheatgrass	Agropyron smithii
Prarie Pepperweed	Lepidium densiflorum

TABLE 1. (Continued)

Common Name	Latin Name
Quackgrass	Agropyron repens
NeedleandThread Grass	Stipa comata
Curly (Galleta) Grass	Hilaria jamesii
Crytograms (Lichens)	--
Threadleaf Groundsel	Senecio longilobus
Locoweed	Astragalus spp.
Wild Oat	Avena fatua
Hedgehog cactus	Echinocereus engelmanii
Cattail	Typha latifola
Alkali Seepweed	Suaeda fruticosa

Climate in the study area is typified by hot dry summers and cold winters. An average of 60 days may be expected to exceed 90°F, and 160 frost-free days between last killing frost and the first of the following season are typical (Richardson et al. 1981a:59; 1981b:63). Table 2 summarizes key temperature data for the town of Cisco, also applicable to the study area.

FAUNA

A variety of small fauna, including mammals, birds and lizards as well as larger ungulates, was observed in the project area. Deer antlers were abundant in survey units atop the first terrace below the Book Cliffs in the juniper/sage vegetation zone. (Table 3 presents a partial list of observed fauna.)

DISCUSSION

Environmental features of any area are interwoven in that one feature will often determine or limit the others in the area. The underlying rock strata, to a large degree, determine the soils, which in turn, are conducive to the growth of a limited number of vegetation types. The seasonal appearance of a variety of plant species attracts a particular set of fauna, including man. The availability of water, especially in a marginal environment such as the Cisco Desert, plays a major role, since man's very survival hinges on its regular and predictable availability.

TABLE 2. Key Temperature Data for Cisco Area.

Mean Annual	Mean Annual Maximum	Mean Annual Minimun	High	Low
51.9	67.7	36.0	109	-26

After Wormington 1955.

TABLE 3. Fauna Observed During Cisco III Survey.

Common Name	Latin Name
Mule Deer	Odocoileus hemionus
Pronghorn Antelope	Antelocapra americana
Coyote	Canis latrans
Badger	Taxidea taxus
Golden Eagle	Aquila chrysaetos
Lesser Nighthawk	Chordeiles acutipennis
Loggerhead Shrike	Lanius ludovicianus
Marsh Hawk	Circus cyaneus
Gambel's Quail	Callipepla gambelii
Western Meadowlark	Sturnella neglecta
White-tailed Prairie Dog	Cynomys leucurus
Desert Cottontail Rabbit	Sylvilagus audoboni
Black-tailed Jack Rabbit	Lepus californicus
Kangaroo Rat	Dipodomys ordii
Pocket Mouse	Perognathus apache
Collared Lizard	Crotaphytus collaris
Leopard Lizard	Gambelia wislizsenii
Short Horned Lizard	Phrynosoma douglassi
Midget Rattlesnake	Crotalus viridis
Gopher Snake	Pituophis melanoleucus

CHAPTER III

CULTURAL HISTORY OF THE CISCO DESERT REGION

This section presents a synopsis of the known prehistoric and historic cultural resources of the general project area and surrounding region and summarizes some of the theories and controversies concerning the culture groups of the Colorado Plateau. Known archaeological resources in the general area indicate that the prehistoric period can be subdivided into four major temporal/cultural stages: Paleo-Indian, Archaic, Fremont and Shoshonean. Current data are inconclusive regarding the local developmental sequence.

PALEO-INDIAN STAGE

The Paleo-Indian Stage is commonly recognized as being divided into the Llano, Folsom and Plano Traditions to describe the diagnostic features (Jennings 1974:81). Although theories have been advanced concerning a pre-projectile point phase (Reed and Scott 1982:334), no evidence has been found in the project area to substantiate its presence. Occasional Folsom points have been found widely scattered over the Plateau region, sometimes in association with an early Pinto variant (Hunt and Tanner 1960:111). No Folsom points have yet been recovered from the project area. The Plano Tradition, from 7000-5000 BC (9000-7000 BP) offers the earliest cultural evidence from the study area in the form of an isolated Cody knife found in "The Grassies" area of the Cisco Desert (Kvamme 1979). A parallel-flaked lanceolate point midsection of possible Cody Complex affiliation was located during the present study and is consistent with this earliest suggested utilization of the area.

ARCHAIC STAGE

By ca. 5500 BC (7500 BP), environmental conditions which supported the Pleistocene megafauna had changed to a situation favoring smaller game animals. Subsistence strategies probably remained similar, but expanded to include a wide variety of plant species from different ecological niches, which were systematically exploited on a season basis. Tool kits were specialized in response to the enlarged resource base. Principal modifications were the advent of stemmed/notched point traditions, with styles evolving at a relatively rapid rate compared to the earlier cultural complexes, and the increasing utilization of groundstone for plant processing. Artifacts of Archaic age were found both on sites and as isolated finds during the present study.

The Early Archaic Stage in Utah partially overlaps the Plano Tradition of the Paleo-Indian Stage. A number of rockshelters and cave sites on the Plateau have provided evidence of this overlap, as well as defining an Archaic cultural sequence. Walters and Cowboy Caves provided C-14 dates of ca. 6875 BC (8875±125 BP) and ca. 6690 BC (8690±75 BP), marking the earliest known occupation of the Colorado Plateau (Schroedl 1976:24). Associated artifacts suggest an Archaic, rather than a Paleo-Indian lifestyle.

Using data from Cowboy Cave and Sudden Shelter, Schroedl (1976) has devised a regional Archaic chronology, broken into four phases, each signaled by the appearance of new projectile point types and/or population fluctuations. The following description of the Colorado Plateau Archaic has been taken largely from Schroedl's 1976 dissertation. Point styles are emphasized, as many of these styles were found during the present study, and provide the most sensitive method of temporal control in this area.

The earliest phase is the Black Knoll Phase, 6350-4250 BC (8300-6200 BP). The beginning of this phase was marked by the efflorescence of the Elko Corner-Notched dart point, a style which remained popular through the Proto-Historic era. Pinto Series points became popular during the latter half of the Black Knoll Phase, suggesting ties with the Great Basin and, to a limited extent, with Southwest populations. An early Pinto variant has been found on the same site as Folsom points, and together, the styles form the Moab Complex (Hunt and Tanner 1960:111).

The succeeding Castle Valley Phase, 4250-2550 BC (6200-4500 BP), was characterized by a similar subsistence pattern as those of the Black Knoll Phase. Point styles diversified to include Rocker Base, Sudden and Hawken Side-Notched points. Humboldt points appeared during the latter half of the period and soon became the prevalent style.

The Green River Phase, 2550-1350 BC (4500-3300 BP), is signaled by a newly arisen dichotomy in point styles between the western and eastern sections of the Plateau. The western variant includes San Rafael Side-Notched and Gypsum points, while the eastern variant is predominated by Duncan-Hanna points. The latter style suggests ties with the Great Plains, where the style was first identified, and ultimately, with the Front Range of the Rocky Mountains, where the earliest date for "proto-McKean" points, 4050 BC (6000 BP), has been established (Benedict and Olson 1973:325).

The final Archaic phase defined by Schroedl is the Dirty Devil Phase, 1350 BC-AD 450 (3300-1500 BP). The phase is not well represented archaeologically and shows few innovations in projectile points, but rather exhibits continuity from earlier phases by the continued use of Gypsum and Elko Series points. Items such as unfired clay objects, basketry and sandals distinguish this phase more than projectile points. The end of the Dirty Devil Phase is signaled by the advent of smaller projectile points. Larger points, i.e., Elko Corner-Notched and Gypsum, remained in use, but more as cutting tools than projectile points (Madsen and Berry 1975:394).

FORMATIVE STAGE

Formative stage groups north of the Colorado River are generally recognized as members of the Fremont culture. The origin of the horticulturally-based Fremont, AD 450-1200 (1500-750 BP), remains a topic of debate, with some authors (Husted and Mallory 1967; Marwitt 1970; Aikens 1970; Schroedl 1976) supporting *in situ* development of the culture from local Archaic antecedents, and others (Gunnerson 1960, 1969; Madsen and Berry 1975) suggesting migration from contiguous culture areas, i.e., the Southwest and Great Plains. None deny Southwestern influence on all or part of the Fremont, whose cultural remains appear basically Puebloan. Great

Plains influence is suggested on at least the northern periphery (Aikens 1966), however, the extent and form of the influence is the core of the problem. Theories range from a diffusion of Southwestern cultural elements to an indigenous Archaic population, to the migration of a Basketmaker II level population from the Virgin Anasazi area (Gunnerson 1969:170; Aikens 1972:63).

The Fremont culture is normally divided into five regional variants: San Rafael, Parowan, Sevier, Great Salt Lake and Uinta (Marwitt 1970), with the divisions undergoing periodic revision as new data emerge. A more recent reappraisal posits that distinct cultures, rather than regional variants, occupied the area north of the Colorado River (Madsen 1979:75). The Fremont occupied the area included in the present study tract, while the surrounding areas to the west and north are attributed to the Sevier and an unnamed Great Plains-derived culture. This definition of horticulturalists north of the Colorado River as distinct culture groups may be a more accurate interpretation, as no single early stratum has yet been found to provide a basis for later variation (Aikens 1972:61). The Fremont culture may have been a separate entity from the beginning, with the ascribed local variants actually being of different origins or cultural influences.

Material culture remains indicate that the Fremont were not completely sedentary, with hunting and gathering of wild resources remaining a critical element of their subsistence activities (Reed 1984:31). Characteristic Fremont projectile points include Rose Spring, Desert Side-Notched, Gypsum and the Elko Series. Ceramics include graywares, several variations of black-on-white and polychrome wares (Ambler 1966:31). Most of these point styles, and several varieties of grayware ceramics were recorded during this project.

The Turner-Look site, which may represent a southern extension of the Uinta Fremont (Schroedl and Hogan 1975; Lindsay 1976), is located directly adjacent to the project area. Living in semi-subterranean houses of dry-laid masonry, the inhabitants cultivated corn and possibly squash. Diagnostic artifacts, including Uinta Gray ceramics, place occupation of the site to AD 1050 or later (Wormington 1955:75; Jennings 1978:156).

LATE PREHISTORIC/PROTOHISTORIC STAGE

Around AD 1300 (650 BP), the horticultural lifestyle of the Fremont was abandoned and replaced by an Archaic subsistence pattern reliant on hunting and gathering of seasonal resources. Numic-speaking Shoshonean groups, primarily the Weiminuche band of the Utes, were present in the area as early as 1598 when the first Euro-American contact was made (Hauck 1977:76). Whether the Ute Tradition represents a reversion by the Fremont to an Archaic-type lifestyle or an intrusion of people from the Great Basin remains a matter of contention (Gunnerson 1969:185; Aikens 1972:62; Jones and McKay 1980:57).

Because Ute sites often lack the typical small side-notched points or crude grayware ceramics commonly attributed to their culture, their remains can be easily confused with cultural material falling anywhere in the cultural continuum from Paleo-Indian to Ute, whose pedestrian hunting-

gathering subsistence strategies left similar archaeological evidence. The nearest recorded structural evidence of Ute occupation is in the Uinta Basin some 70 miles to the north (Chandler and Nickens 1979). A diagnostic knife, a site containing post-contact glass beads and a site radiocarbon dated to ca. AD 1840 (110±50 BP) present firm evidence of Late Prehistoric/ Protohistoric presence in the Cisco III study area.

EURO-AMERICAN CONTACT

The first documented visit to the Cisco Desert region by non-aboriginals was the Dominquez-Escalante Expedition of 1776, although it is possible that traders from New Mexico visited the area earlier in the same century (Pierson 1981:75-76). The northern route of the Old Spanish Trail, in use through the middle of the 19th century, also ran through some portion of the Cisco Desert (Ibid:78-79). The area was traversed by trappers in the 1820s through 1840s, as evidenced by the Robidoux inscription (1837) at the head of Westwater Creek. Exploration and travel continued through the region culminating with completion of the Denver and Rio Grande Western Railroad in the project area in 1883 (Mehls 1982:84). The cattle industry predominated in the late 19th century, but sheep grazing replaced cattle as the major land use around the turn of the century (Reed and Nickens 1980:48). Exploitation of the oil and gas resources in the Cisco Desert was underway by at least the 1920s (Pierson 1981:94), and continues through the present day. Other current land use includes cattle grazing and farming with irrigated fields. The majority of the small homesteads/ranches established at the canyon mouths in the early 20th century have been abandoned.

CHAPTER IV

CULTURAL RESOURCES IN THE PROJECT AREA

One hundred twenty-six sites were recorded during the Cisco III cultural resources survey. This total includes 111 aboriginal sites (Figure 13) and 15 historic sites (Figure 14), one of which (42GR1714) is a prehistoric site with an overlying historic component. Summaries of prehistoric and historic site attributes are included as Appendices 2 and 3. A total of 129 isolated finds, 103 aboriginal, 25 historic and 1 human tooth of indeterminable age, was recorded in the study area.

The high site density areas along Cottonwood Wash and Westwater Creek are recommended as eligible for nomination to the National Register of Historic Places (NRHP) as proposed archaeological districts. Diagnostic artifacts indicate utilization of these areas from the Early Archaic through Late Prehistoric/Protohistoric periods, with possible Paleo-Indian utilization indicated for the project area at large. Carbon samples provided C-14 dates of ca. AD 1840 (110±50 BP) and ca. AD 140 (1810±70 BP) for sites 42GR1658 and 42GR1680 respectively. Charcoal was recovered from two other sites, but was not analyzed.

PREHISTORIC RESOURCES

Site Types

Prehistoric sites were defined as areas exhibiting evidence of prehistoric cultural activity containing five or more flakes, tools or ceramics; sheltered rock overhangs showing evidence of cultural use; or any feature, i.e., hearth. Analysis of descriptive attributes allowed a breakdown of sites into four major categories with subtypes based on specific attributes. Site types and the total of each recorded, are listed in Table 4.

The majority of the sites were placed into one of two categories based on the presence/absence of groundstone or evidence of a hearth (Table 4). If either or both of these were present, the site was deemed a campsite, presumably the locus of multiple or long-term (at least overnight) activity. Campsites totaled 51, or 45.94% of the aboriginal site inventory. Sites lacking these traditional diagnostics numbered 49, or 44.14% of the aboriginal site inventory, and were called lithic scatters, those localities which exhibit evidence of short-term or limited activity. See Figure 15 for distribution of campsites and lithic scatters.

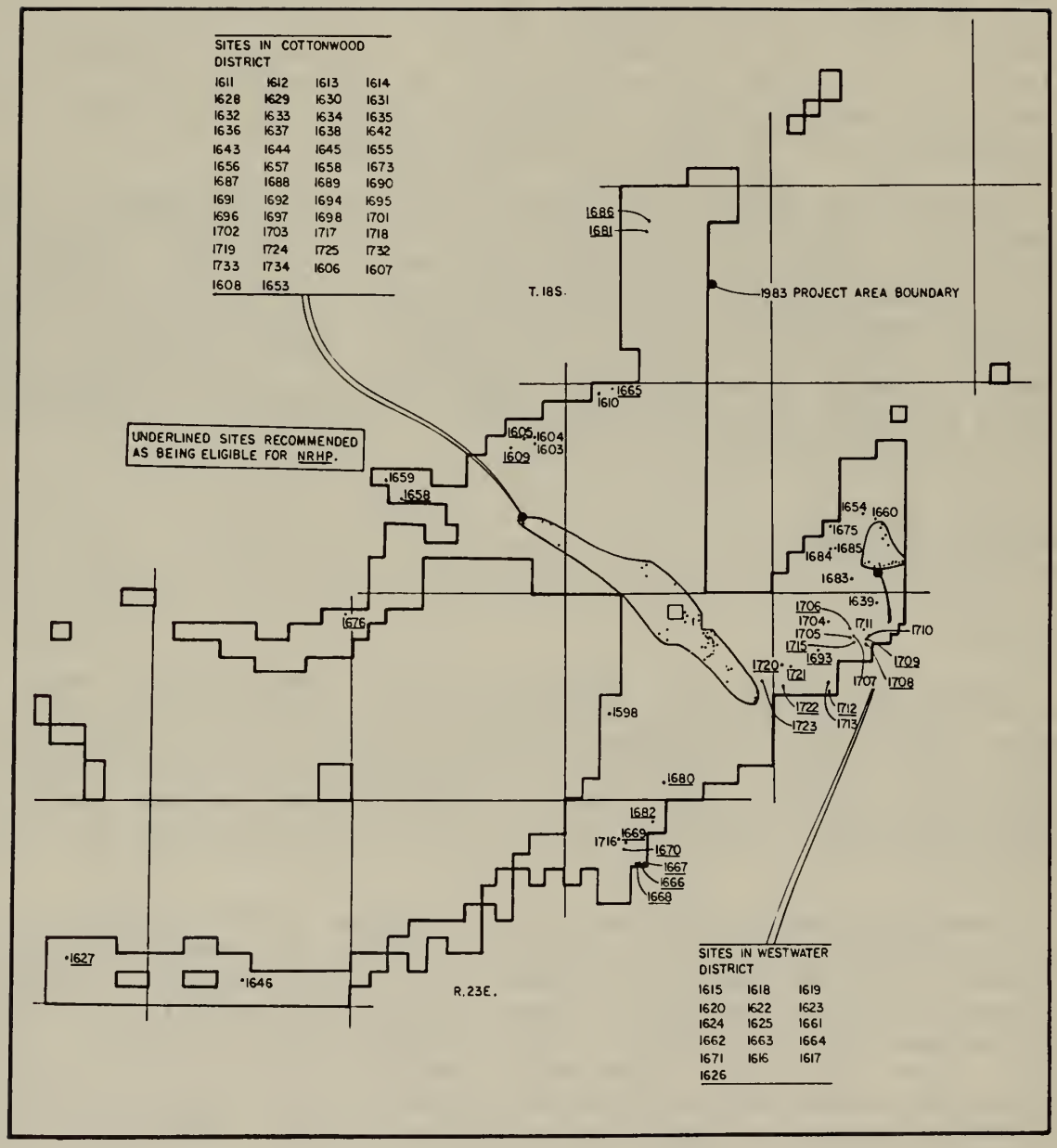


FIGURE 13. Prehistoric Site Locations and NRHP Recommendations.

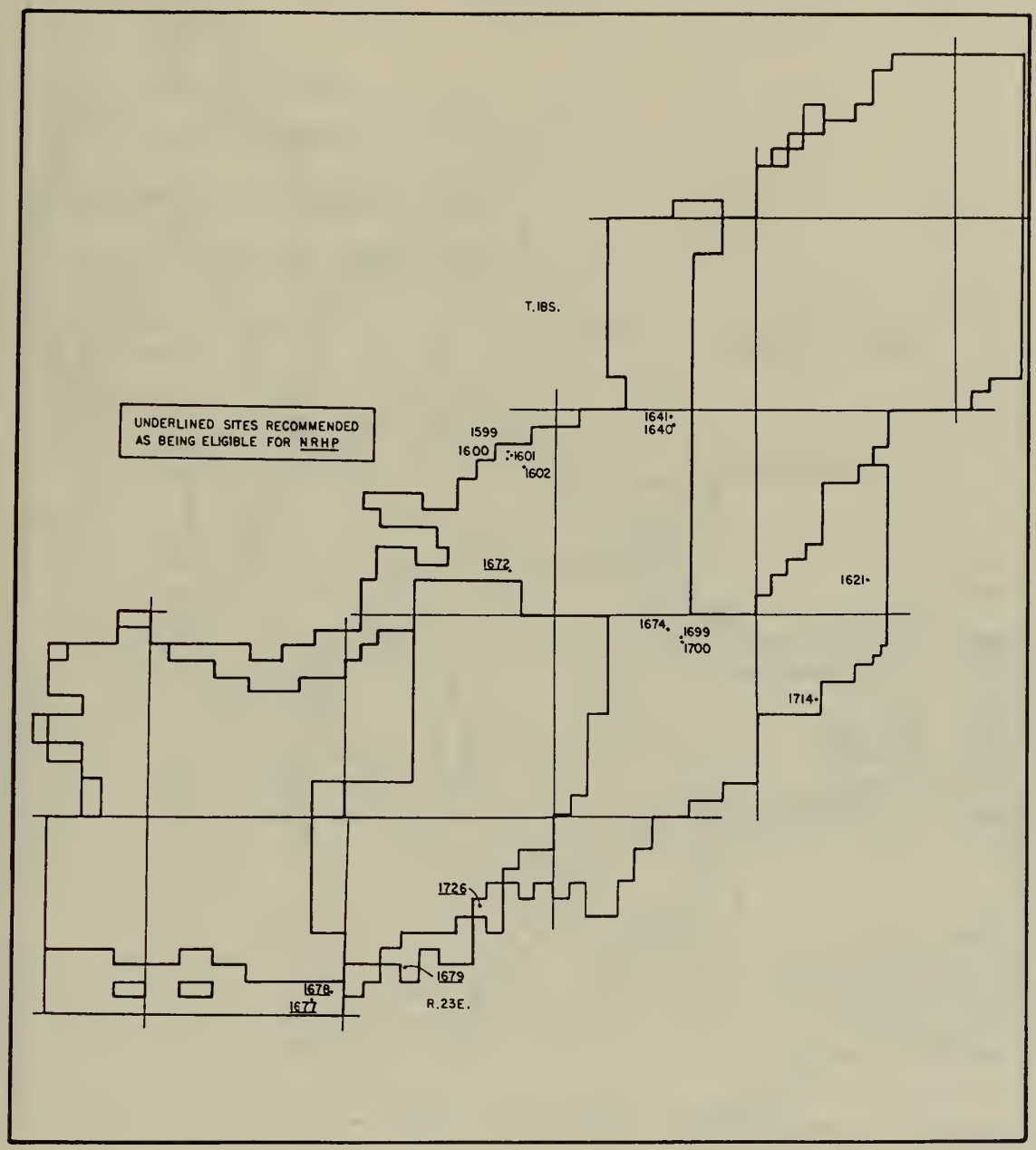


FIGURE 14. Historic Site Locations and NRHP Recommendations.

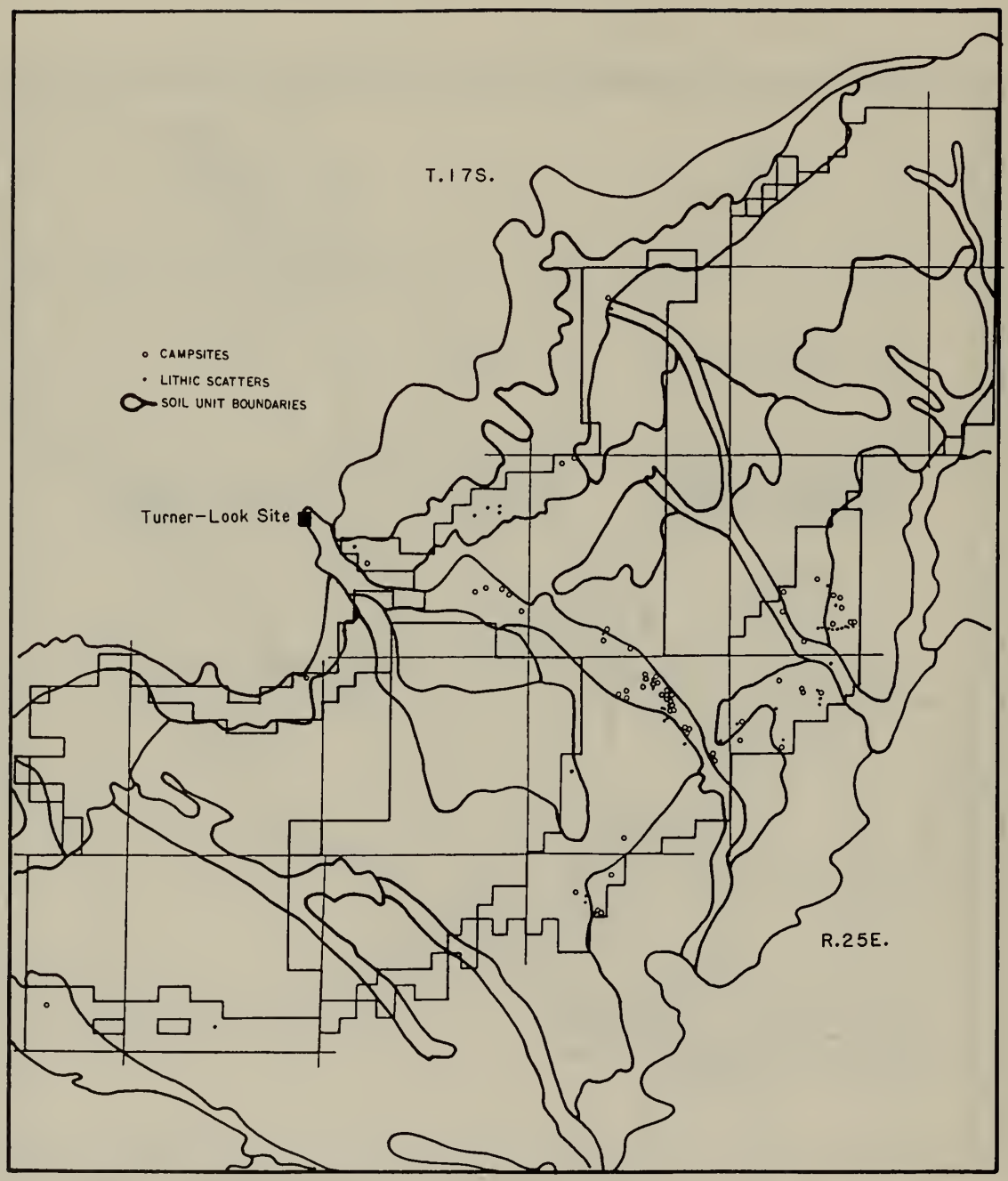


FIGURE 15. Cisco III Prehistoric Campsite and Lithic Scatter Locations with General Soil Unit Boundaries.

TABLE 4. Site Type Frequencies.

Site Type	Total	Percentage
Lithic Scatter	46	41.44
Lithic/Ceramic Scatter	3	2.71
Campsite with Hearth(s)	42	37.84
Campsite with Groundstone	5	4.50
Campsite with Hearth and Groundstone	4	3.60
Rockshelter	6	5.40
Quarry	2	1.80
Quarry and Campsite with Hearth(s)	3	2.71
Total	111	100.00

While most sites may be placed clearly into one of these two categories, some sites may be misclassified due to burying or mixing of cultural deposits. This would be a significant factor especially when considering sand dune sites, where repeated deposition and deflation obliterate cultural features. Six rockshelters, or 5.40% of the site inventory, were found below the sandstone caprock topping the mesas northwest and southeast of the desert lowlands. All rockshelters contained charcoal or burned rock and are assumed to have been habitations or campsites.

Five quarry sites, or 4.50% of the prehistoric site inventory, were found in the Summerville Formation outcrops in the river cliffs along the south side of the project area. These outcrops provided most of the chert and some of the chalcedony material types found on sites during the Cisco III project. Three quarries had associated campsites and were designated as such in the site tallies.

In an attempt to test the validity of using the presence of groundstone and/or a hearth as indicators of campsites vs. lithic scatters, discriminant analysis was performed using nine variables. The variables measured for each site were: points, bifaces, edge-retouched flakes, cores, hammerstones, choppers, dominant flaking stage, number of material types and site size.

Intuitively, it was felt that campsites were occupied for longer periods of time and therefore would contain a variety of tool types designed for a broad range of specific tasks. They may also exhibit a variety of tool reduction stages and/or types and amounts of flake material. Lithic scatters, on the other hand, should be more restricted in terms of these variables. Therefore, the experiment was set up so that:

H_0 No difference exists in lithic content between "camp sites" and "lithic scatters," and

H_1 The material remains of "campsites" vs. "lithic scatters" differ in terms of lithic content.

If the activity at the two site types actually differed, a quantifiable difference should exist in material remains enabling more accurate identification of sites lacking the traditional diagnostics.

Discriminant groups were defined a priori. Group 1 included the 51 campsites and Group 2 included 49 lithic scatters. The analysis showed that 95% of Group 1 was correctly classified, while only 15% of Group 2 was correctly classified. While the frequencies of edge-retouched flakes and points were the most discriminating variables, the groups appeared similar overall in terms of the variables selected, and were not effectively discriminated. Taken in sum, there is only a 50% chance that the lithic scatters and campsites differ in lithic content.

For the purpose of this test, the null hypothesis could not be rejected. No significant difference was found in cultural material remains between campsites and lithic scatters. Until such time that more complete methods of site identification are developed, the traditional diagnostics of groundstone and/or hearth will have to suffice for distinguishing campsites from lithic scatters.

Material Culture

Material Types

Flaked stone artifacts, including formal tools, cores, and debitage, were the most common cultural remains found in the project area. Tool manufacturing waste flakes were by far the most common, with 3,168 flakes recorded. This represents a sample of the flakes located on recorded sites, as transects were used to sample the lithic population on large sites. Five basic material types were represented. In order of their prevalence, these were: chert, chalcedony, quartzite, basalt and obsidian. Chert and chalcedony are both waxy-appearing cryptocrystallines which occur in a wide range of colors. Their principal difference, for the purpose of this project, is that chert is generally opaque while chalcedony is more translucent.

Chert material of many colors was observed outcropping in the Brushy Basin Member of the Morrison Formation, present in deposits up to 450 feet thick (Barnes 1978:57) in the color-banded river cliffs southeast of the project area, near the Colorado River. The second most common toolstone observed was chalcedony, which outcrops in the Summerville Formation (Cashion 1973; Powers 1983) found south of the study area and in Arches National Park (Berry 1975). Quartzite, metamorphosed sandstone, is generally gray or white in color, but ranges in some areas from red to green to black. It is generally granular in character, ranging from fine to coarse-grained, with recrystallized quartz cementing the grains. Quartzite cobbles were found in drainages and eroded areas of the Morrison Formation on the south side of the project area. Basalt and obsidian are igneous materials differing mainly in that obsidian is a natural glass while basalt lacks the glassy character. Black is the most common color, but both can occur in a wide range of colors depending on the chemical content of the particular volcanic extrusion. Neither basalt nor obsidian occurs naturally within the project area. Trace element analysis for the purpose of source identification was performed on five obsidian flakes and one point, but results were inconclusive. The relative frequency of all recorded flake materials and their percentages is presented in Table 5.

Artifact Classes

On a more formal level, cultural materials include chipped and groundstone tools, ceramics, and a number of historic Euro-American artifacts, the latter to be discussed in a separate section. The following discussion describes the general classes of artifacts encountered during the survey.

Projectile Points (32 specimens)

Projectile points are bifacially retouched and thinned, generally symmetrical tools exhibiting a modified base for the purpose of hafting onto a spear, dart or arrow (Crabtree 1972). The majority of the points are manufactured from cryptocrystalline material, i.e., chert and chalcedony; materials that can be worked to a sharp edge but can be brittle and subject to high edge attrition when used for cutting, sawing or piercing (Toll 1978:1; Nickens 1979:62).

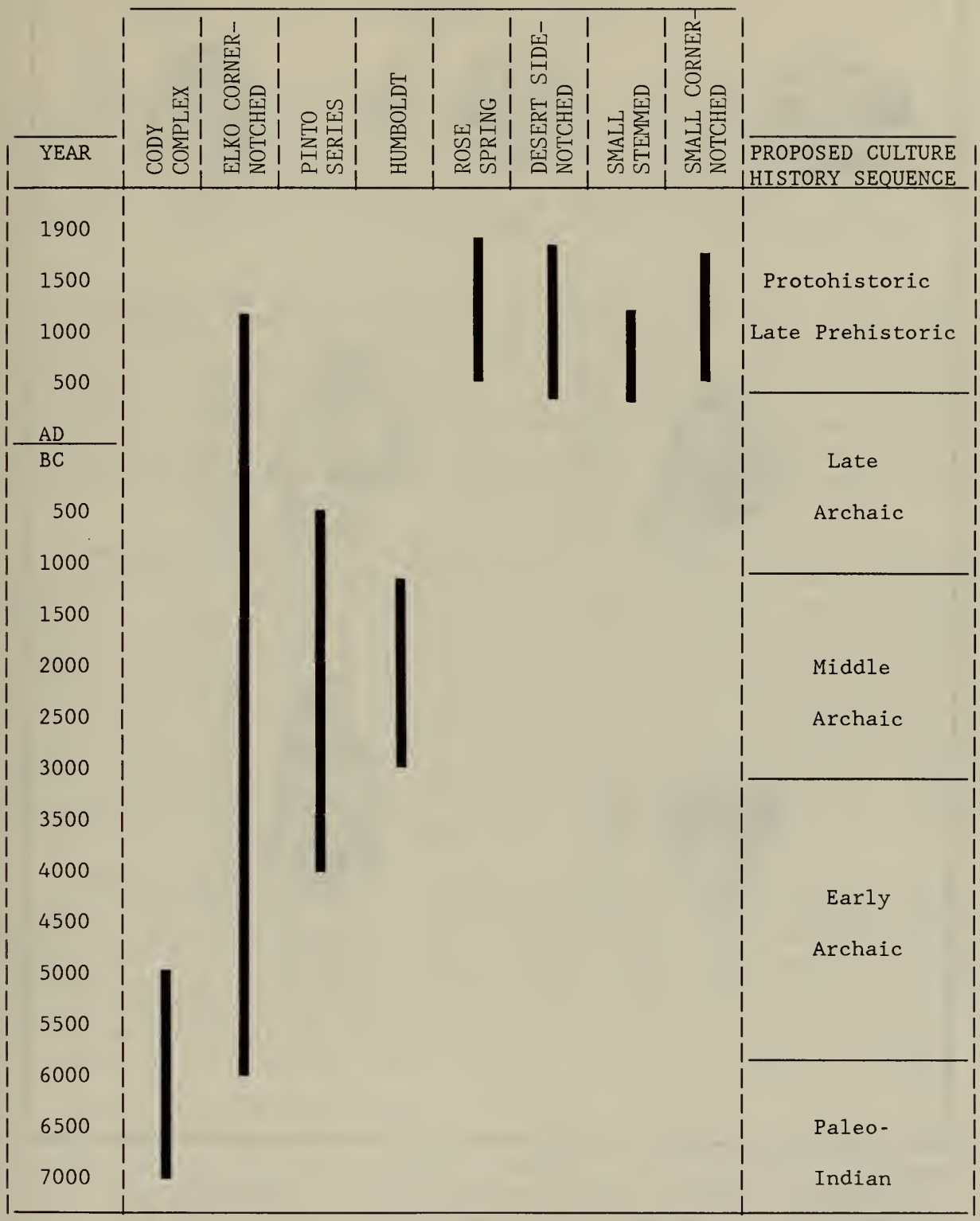
Twenty-five diagnostic projectile points were collected from site contexts, providing temporal control for 19 sites, while 7 were isolated finds. Table 6 provides proposed temporal spans for eight distinctive point types found during the Cisco III survey. Some overlap in dates exists depending on the author consulted, and the longest suggested time spans of use have been indicated.

Large Corner-Notched Points (7 specimens; Figure 16). Large corner-notched points are the best represented (24%) of the types found in the project area. Attributed to the Elko Corner-Notched complex in this area (Holmer 1978), large corner-notched points are common throughout the western states. They are of little diagnostic value in temporal studies since they first appear during the Early Archaic, ca. 6000 BC (Schroedl 1976:61), and

TABLE 5. Percentages of Material Types.

Material	Total Number of Flakes	Percent of Total Flakes
Chert		
Maroon	740	23.3
Brown	323	10.2
White	270	8.5
Gray	135	4.2
Other	323	10.2
	1,791	56.4
Chalcedony		
White	501	15.8
Gray	65	2.0
Other	182	5.7
	748	23.5
Quartzite		
White	237	7.5
Gray	158	5.0
Other	80	2.5
	475	15.0
Basalt	140	4.4
Obsidian	9	.2
Petrified Wood	2	.06
Other	3	.09
Total	3,168	99.65

TABLE 6. Proposed Projectile Point Temporal Spans.



After Schroedl 1976, Holmer 1978, Gunnerson 1969 and Aikens 1970.

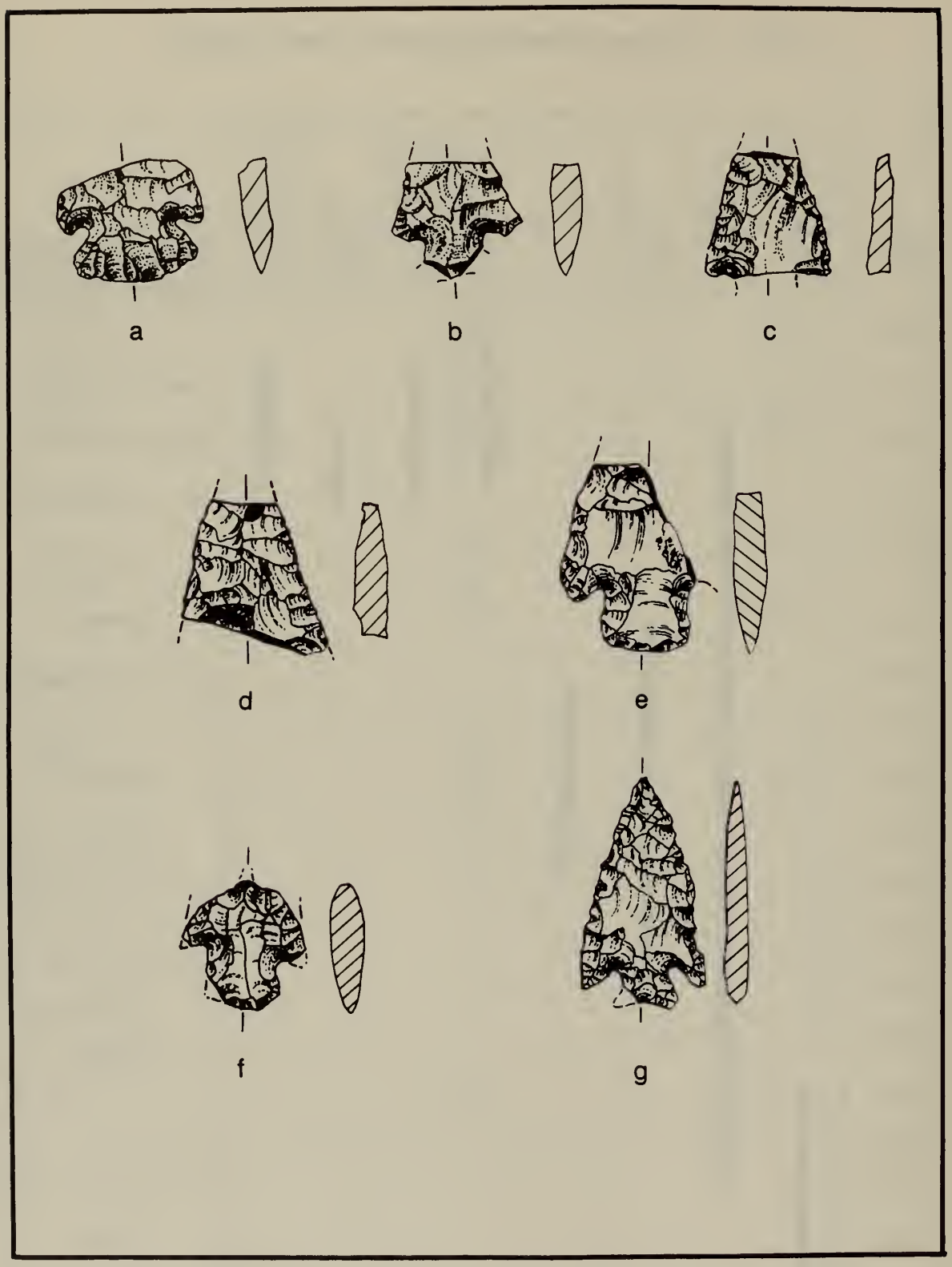


FIGURE 16. Large Elko Corner-Notched Points. a) 42GR1616.1, b) 42GR1617.1, c) 42GR1635.1, d) 42GR1671.1, e) 42GR1676.1, f) 42GR1681.4, g) IF106. Drawings actual size.

apparently remained in use through the Late Prehistoric, ca. AD 1350 (Madsen and Berry 1975:394). Mean measurements for the seven points are: Length: too fragmentary for accurate measurement (The single complete specimen is 3.9 cm.), Width: 2.21 cm., Thickness: .47 cm.

Large Side-Notched Points (1 specimen; Figure 17, a). The single point in this category is similar to Type 4F found at Serviceberry Shelter (5MF81) in Dinosaur National Monument (Breternitz 1970:140, Figure 9g-o). The style was subsequently C-14 dated to 3660±280 BC at Mummy Cave in northwest Wyoming, suggesting Early Archaic manufacture. The point measures: Length: 2.5 cm. (fragmentary), Width: 2.0 cm., Thickness: .5 cm.

Medium Corner-Notched Points (5 specimens; Figure 17, b-f). Medium corner-notched points are morphologically similar to the large corner-notched variety, but narrower and somewhat thinner. They also may be classified as Elko Corner-Notched points, and were apparently in use from ca. 6000 BC to AD 1350 (Holmer 1978). A C-14 date of ca. AD 140 (1810±70 BP) from site 42GR1680, which produced points depicted in Figures 17c and d places the points in a Late Prehistoric framework. Mean measurements of the five points are: Length: too fragmentary for accurate measurement, Width: 1.78 cm., Thickness: .38 cm.

Lanceolate Points (5 specimens; Figure 18). Four of these points are unnotched basal portions, two with concave bases and lateral and basal edge grinding. One specimen (Figure 18, b) appears to be a Humboldt point (Heizer and Hester 1978:26) and another (Figure 18, c) may be a McKean Lanceolate (Reed and Nickens 1980:30). The points are of Middle to Late Archaic manufacture, dating from ca. 3000 to 500 BC (Holmer 1978:72). The third (Figure 18, a) is an unidentified type, possibly a preform. A fourth (Figure 18, d), is also unidentified. The fifth specimen (Figure 18, e) is a midsection of a large parallel-sided point. The parallel collateral flaking suggests Paleo-Indian, possibly Cody Complex affiliation. Mean measurements of the points are: Length: too fragmentary for accurate measurement, Width: 2.08 cm., Thickness: .44 cm.

Pinto Series Points (6 specimens; Figure 19). The points in this category represent three styles of the Pinto series: shoulderless, sloping-shoulder and square-shoulder (Heizer and Hester 1978:28, Holmer 1978:42; Jennings et al. 1980:69). Two points are complete, and three have ground hafting elements. Pinto points appeared during the Early Archaic, ca. 4250 BC, and remained in use through the Late Archaic, ca. 670 BC (Schroedl 1976). Mean measurements of the points in this category are: Length: 2.7 cm. (based on two complete points), Width: 1.82 cm., Thickness: .48 cm.

Small Side-Notched Points (4 specimens; Figure 20). Three points in this category (Figure 20, a, b, and c) are of the Desert Side-Notched variety, suggesting Fremont or Ute occupation, ca. AD 440 to 1720 (Gunnerson 1969: Figure 43, d). The cultural affiliation of the remaining point (Figure 20, d) is unknown, but it appears to be a Late Prehistoric/Proto-Historic arrowpoint. Mean measurements of the points are: Length: 3.0 cm. (based on one complete point), Width: 1.52 cm., Thickness: .40 cm.

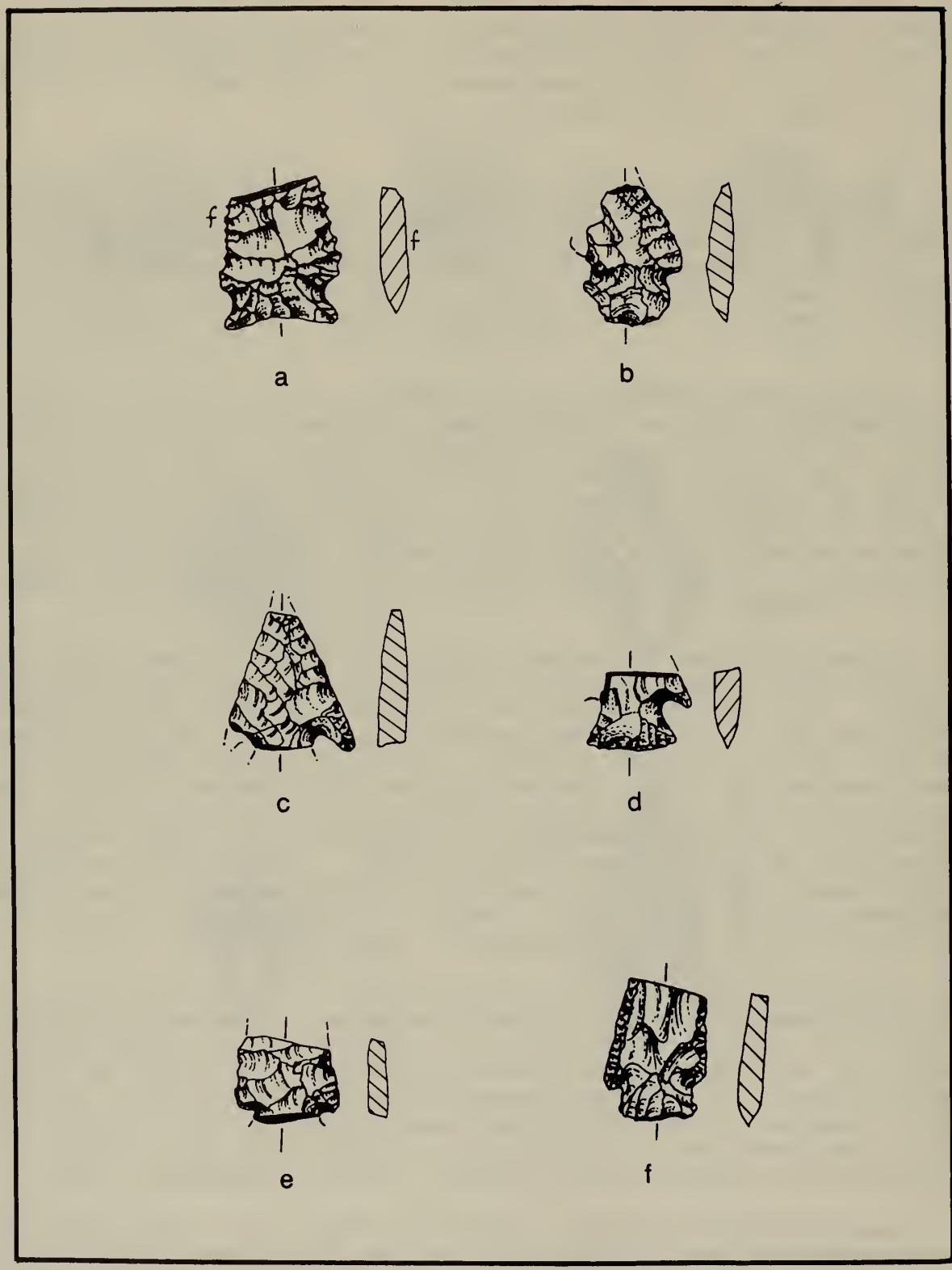


FIGURE 17. Large Side-Notched Point. a) 42GR1612.1. Medium Elko Corner-Notched Points. b) 42GR1676.2, c) 42GR1680.1, d) 42GR1680.2, e) 42GR1706.1, f) IF 129. Drawings actual size.

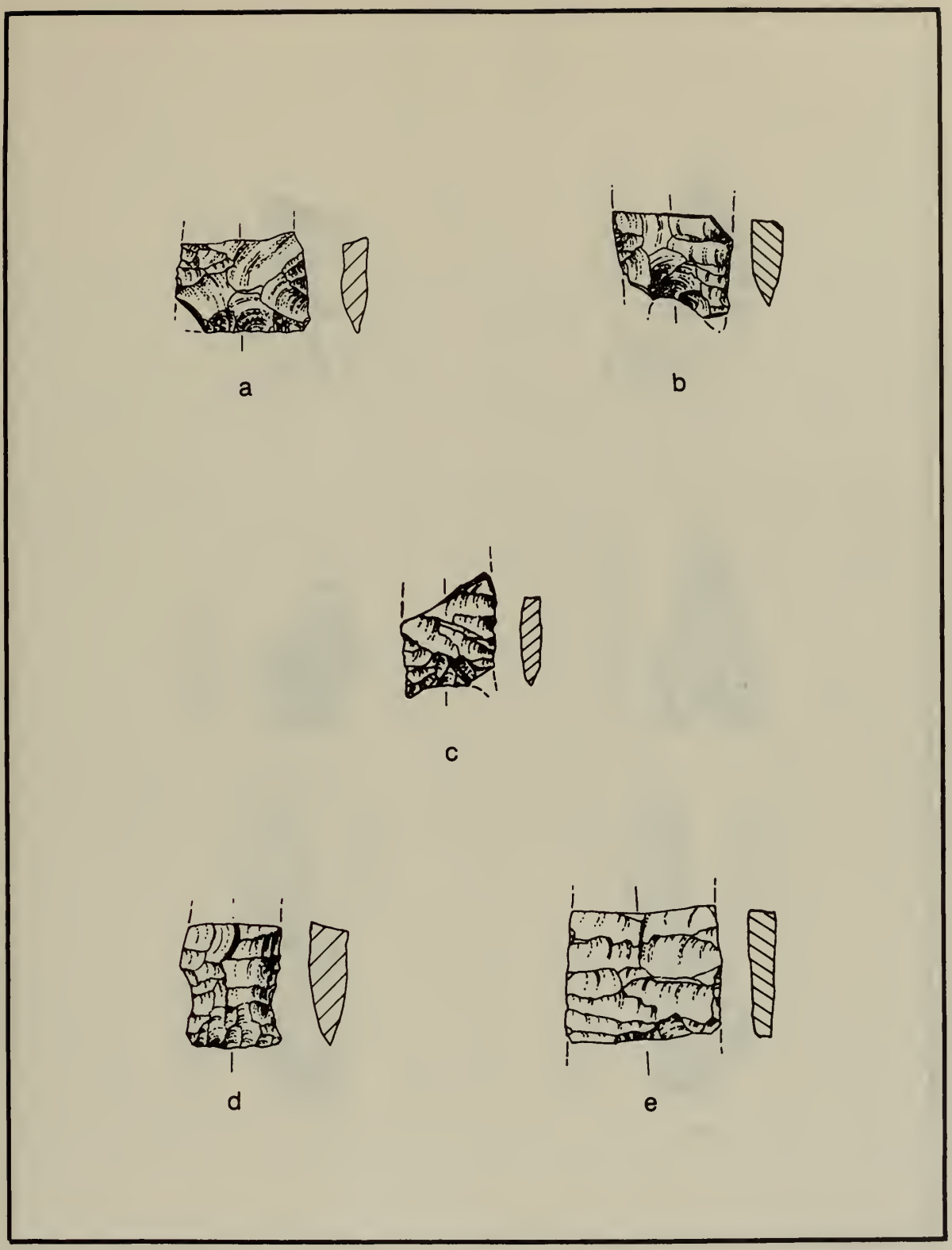


FIGURE 18. Lanceolate Points. a) 42GR1642.1-Unidentified, b) 42GR1698.1-Humboldt?, c) 42GR1707.1-McKean?, d) IF38-Unidentifed, e) 42GR1644.2-Cody Complex. Drawings actual size.

FIGURE 19. Pinto Series Points. a) 42GR1625.1, b) 42GR1625.2, c) 42GR1725.1, d) 42GR1725.2, e) IF81, f) IF100. Drawings actual size.

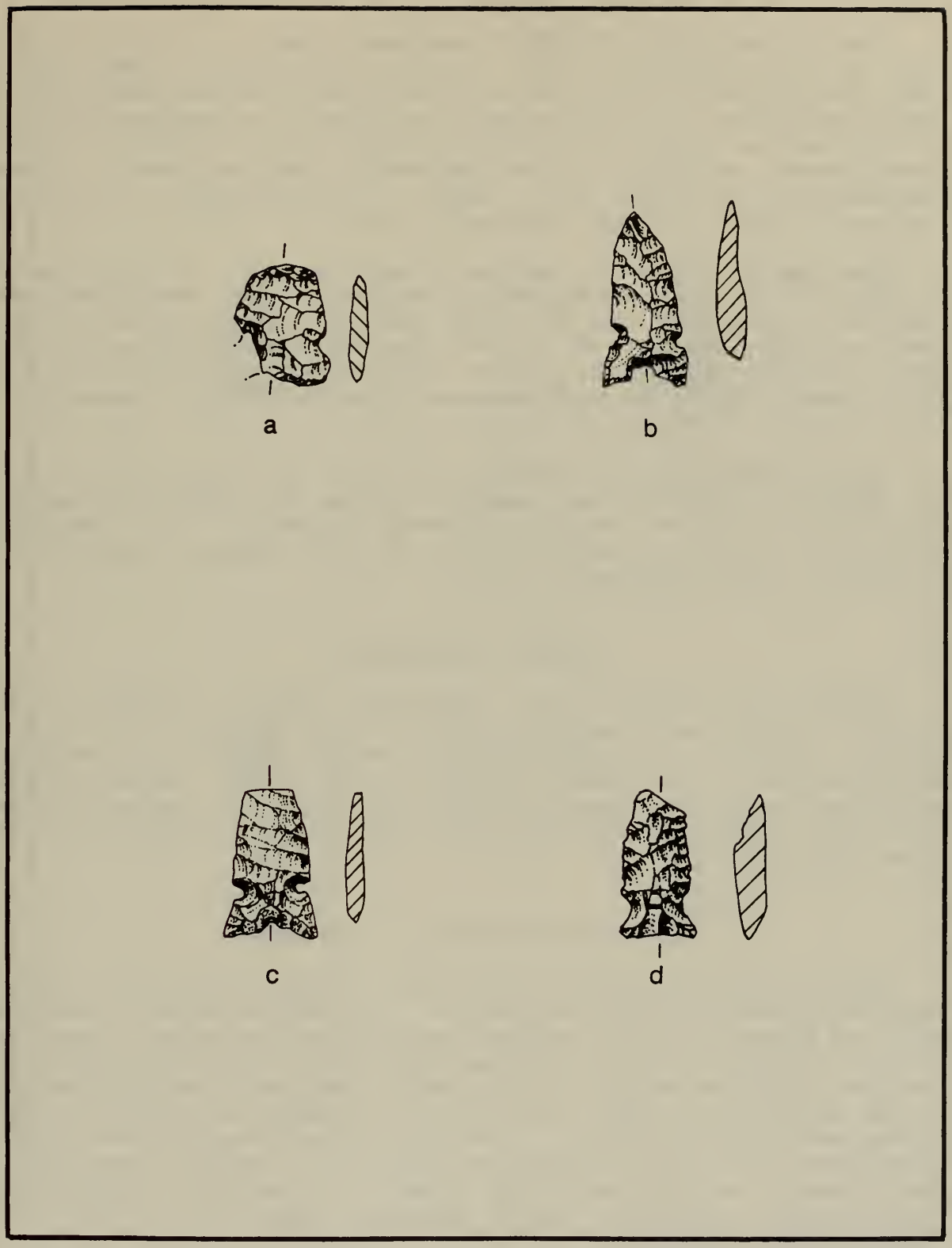


FIGURE 20. Small Side-Notched Points. a) 42GR1676.5-Desert Side-Notched, b) IF85-Desert Side-Notched, c) IF53-Desert Side-Notched, d) 42GR1615.4-Late Prehistoric/Proto-Historic. Drawings actual size.

Small Corner-Notched Points (2 specimens; Figure 21, a and b). The points in this category are of Late Prehistoric/Proto-Historic manufacture, dating from AD 500-1700, for use as arrowpoints (Reed and Kainer 1978). Cultural affiliation of this point style is difficult to determine as it was in widespread use across the Colorado Plateau, Great Basin and Plains culture areas, especially after introduction of the horse. Mean measurements of the points are: Length: too fragmentary for accurate measurement, Width: 1.45 cm., Thickness: .35 cm.

Rose Spring Points (1 specimen; Figure 21, c). A single point attributed to the Rose Spring Series was found. This series may have originated as early as 2500 BC in the eastern Great Basin, but did not appear on the Plateau until ca. AD 500. They appear most frequently during Fremont occupation (Schroedl 1976:74), and remained in use as late as AD 1850 (Aikens 1970:56). The point measures: Length: 3.5 cm. (fragmentary), Width: 2.1 cm., Thickness: .3 cm.

Small Stemmed Points (1 specimen; Figure 21, d). The single point of this variety is complete and resembles a point identified by Gunnerson (1969:Figure 43, f) as indicating Fremont occupation. Its suggested temporal span is from ca. AD 450 to 1200. The point measures: Length: 2.8 cm., Width: .9 cm., Thickness: .3 cm.

Bifaces (72 specimens)

Bifaces are patterned tools exhibiting bifacial retouch of all surfaces, thinning, and a generally acute cutting edge angle. They occur in a variety of forms and therefore imply a variety of potential functions. Subtypes include: 1) preforms, 2) drills, and 3) knives. The majority of the bifaces are made of cryptocrystalline materials. A diagnostic biface (Figure 22) recorded on 42GR1631 has been identified as a Shoshonean knife (Frison 1978:80).

Edge-Retouched Flakes (13 specimens)

Edge-retouched flakes are tools with unifacial or bifacial retouch along one or more selected working edges. They may be formal or expedient tools, and generally receive less edge modification than bifaces, resulting in a more irregular outline. The edge angle along the working edge varies from acute to oblique depending on the desired task, which may have involved cutting, scraping or sawing. Tools such as scrapers and retouched flakes are included in this category. Most oblique-angle edge-retouched flakes (formal tools) are made of coarse materials, i.e., quartzite and basalt, whose inherent qualities make them suitable for heavy-duty scraping and cutting tasks. Retouched flakes (expedient tools) are generally of cryptocrystalline materials.

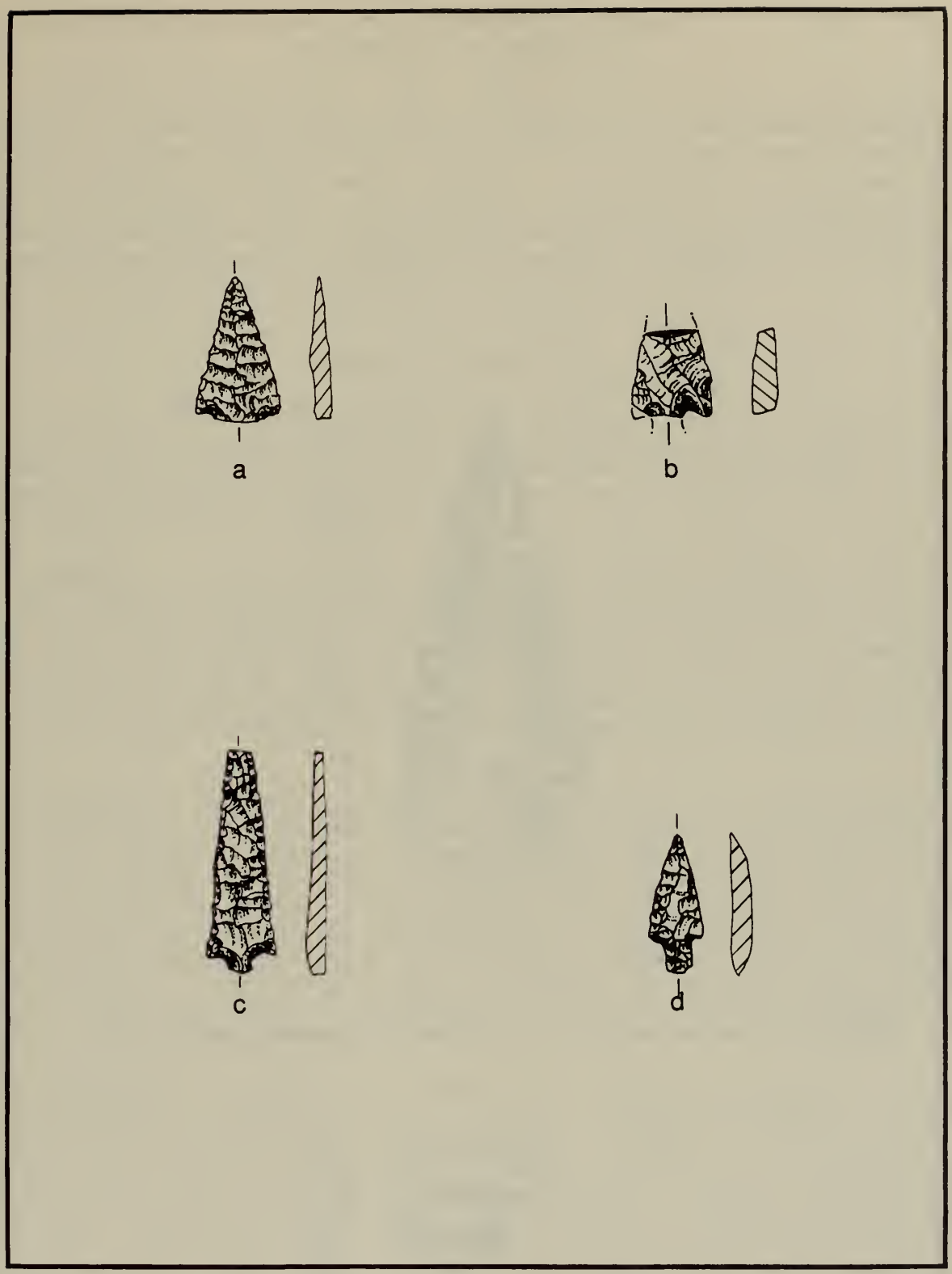


FIGURE 21. Small Corner-Notched Late Prehistoric/Proto-Historic Points.
a) 42GR1607.1, b) 42GR1659.1. c) 42GR1645.1-Rose Spring.
d) 42GR1681-Small Stemmed Fremont. Drawings actual size.

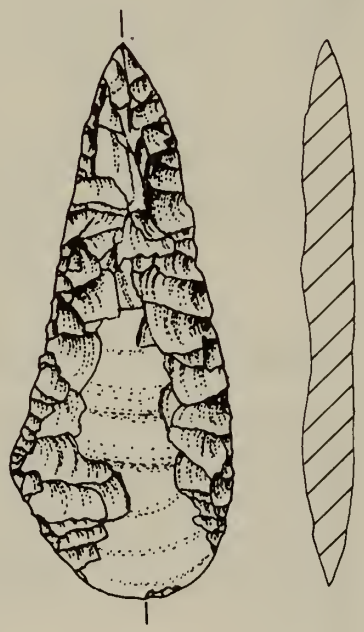


FIGURE 22. Shoshonean knife 42GR1631.1. Drawing actual size.

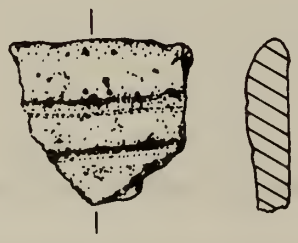


FIGURE 23. Mancos Gray Sherd 42GR1686.1. Drawing actual size.

Groundstone (21 specimens)

Ten sites contributed a total of 21 partial or complete groundstone artifacts. Seven manos were found, four complete. One mano was two-handed and the remainder were one-handed varieties. Two manos were bifacially utilized and the remainder were unifacial. Ten metates, both pecked and nonpecked varieties, of flat slab types were represented. Two were complete and eight were fragmentary. Four groundstone fragments remain unidentified. All groundstone was made of sandstone, and probably transported to the sites from the outcrops bounding the desert on the north and south.

Ceramics (50 specimens)

A total of 50 ceramic fragments was recovered from six sites in the project area. They were examined by Priscilla Ellwood of the University of Colorado Museum and Calvin Jennings of Colorado State University. The following descriptions and classifications were compiled from their observations and those of the authors.

42GR1605 - A total of eight sherds was collected, probably all from the same vessel. Four are body sherds and four comprise the majority of a crude loop handle, similar to what might be found on a mug. The sherds have a gray core, with small-sized, even-grained quartz and igneous rock temper. They showed a positive reaction to a hydrochloric acid test on a fresh break, indicating the presence of calcite. The surface is brownish-gray with some crude polishing evident. The sherds have been classified as Uinta Gray.

42GR1609 - Eight body sherds were noted and collected. The sherds are thick (up to one cm.),and well-fired with a dark brown to brownish-gray core. The temper is made up mostly of large particles of semi-angular quartz protruding through the surface, with some rounded sand grains also noted. Fracture is platy, with smoothing/scraping striations noted on the interior side of the majority of the sherds. Color ranges from a yellow-brown buff to reddish-orange, with some evidence of fire-clouds noted. Two sherds exhibit a slight outward curve, resembling the neck of an olla-shaped vessel. These sherds were classified as Great Salt Lake Gray by Priscilla Ellwood (1984:personal communication).

42GR1613 - Five small body sherds (the largest being 2 cm. long), probably from the same vessel, were collected. The core is gray, as is the surface, which has weathered or chipped away on a portion of all the sherds. Temper consists of large particles of angular, milky quartz, and smaller pieces of sub-angular rock, possibly biotite gniess. Also noted were two or three small particles of white shell, identified by a positive hydrochloric acid test. Temper protrudes through the surface on the pieces where the surface remains. These sherds were also classified as Great Salt Lake Gray.

42GR1665 - Fourteen body sherds were collected. The cores range from dark gray to almost black. Temper consists mostly of crushed and sub-angular quartz, with some mica present. Particle size is medium to small. Sherds are thin, (.4 cm.), compact and of a gray to grayish-brown color. All sherds are classified as Emery Gray.

42GR1676 - One very small (1.4 cm. in length) sherd was recovered. Temper is small pieces of sub-angular crushed rock, possibly feldspar, with a very small percentage of mica, and an almost black core. The exterior is a brownish-gray. Positive classification was not made, however, the sherd most closely resembles those classified as Emery Gray.

42GR1686 - Thirteen body sherds, probably from the same vessel, and one corrugated rim sherd were collected. The core of the body sherds is medium gray, as is the exterior. Temper consists of small particles of angular, crushed dark rock, possibly basalt or biotite gniess; with some fine angular quartz and mica (rare). The outside surface has been polished, and scraping striations are evident on the inside. Some exfoliation has occurred on two of the sherds, and there is a possibility that a slip or float was used. These sherds have been classified as Emery Gray.

The single rim sherd (Figure 23) has a dark gray core with temper consisting of crushed quartz and gniess. The surface is light to medium gray, with some temper protruding. Corrugation is well-smoothed, with no finger or pinch marks. The sherd was tentatively classified as Mancos Gray by Calvin Jennings (1984:personal communication).

Dating the three varieties of Fremont sherds is somewhat difficult as different authors ascribe various beginning and ending dates to both the ceramics and associated cultures. Ellwood (1984:person communication) dates the Uinta Gray (or Turner Gray, Cisco Variety), between AD 650 and 950 while Wormington (1955:75) sets the ending date at ca. AD 1050, based on her work at the Turner-Look site. Madsen and Lindsay (1977) extend the date for the Uinta variant, or unnamed Plains-derived culture, another 200 years. Ellwood gives a range for Great Salt Lake Gray as AD 400 to 1350. She also states that this type is sometimes found associated with Uinta Gray. The range for Emery Gray, associated with the San Rafael Fremont or just the Fremont (Madsen and Lindsay 1977) is given by Ellwood as AD 700 to possibly 1200. She also states that this type is occasionally found associated with Uinta Gray. If we accept Madsen's (1979:75) reappraisal, then all three culture groups are represented in our sample. Given the uncertainty of the archaeological record and disagreement among the experts, this should not be surprising.

Contact with the Mesa Verde Anasazi is represented by a single Mancos Gray sherd (Figure 23). Breternitz et al. (1974:Table 1) gives a range of ca. AD 875 to 950 for this particular ware, although it probably did not occur much before AD 900 north of the Colorado River (Creasman 1981:VI-6). This range fits within that of Emery Gray, found on the same site. Anasazi ceramics have previously been recovered in the Cisco region, most notably at the Turner-Look site (Wormington 1955:74-75).

Analysis of the collected ceramic data adds little to confirm the previously posited theories of Fremont cultural group divisions or locations. It does, however, strengthen the hypothesis that although little or no Anasazi settlement had taken place north of the Colorado River, there was contact between the cultural groups. Additionally, the data do little to separate cultural groups by time sequence. Great Salt Lake Gray has the longest time span (AD 400 to 1350), but all types overlap at ca. AD 900, with overlap continuing for the Fremont types through at least AD 1200. If

all three Fremont cultural groups were not actually utilizing the area, they did, at least, maintain steady contact with one another.

Discussion

A total of 44 temporally/culturally sensitive artifacts or sites was recorded during the Cisco III survey. The 29 diagnostic projectile points, 1 biface, 10 sites with groundstone and 6 sites with ceramics indicate aboriginal use of the Cisco Desert, between the Book Cliffs and the Colorado River, from the Paleo-Indian Stage, Plano period, (prior to ca. 6500 BC) through the Protohistoric (ca. 1877) stages. Figure 24 presents a distribution of site types as indicated by temporal/cultural diagnostics.

The Paleo-Indian Stage is sparsely represented by a single point fragment of possible Cody Complex affiliation. The Archaic Stage is best represented, with 16 sites containing groundstone or points indicative of Archaic occupation. Other point styles suggesting Archaic occupation are Pinto, Humboldt, and McKean Lanceolate. Three sites appear to be multicomponent, with an Archaic, then a later Fremont or Shoshonean component. Ten sites with groundstone and five sites with large corner-notched points also indicate Archaic, or later, occupation. It is possible that inhabitants of a site could have transported a point from an earlier site thus giving a single-component site the appearance of an earlier period or multiple occupation.

Formative Stage sites, or those of Fremont affiliation, are indicated by grayware ceramics and distinctive Rose Spring and small stemmed points. In addition, Desert Side-Notched points may date to this, or the later Late Prehistoric/Protohistoric time period. Trade with the Southwest culture area during the Formative Stage is indicated by the presence of a Mancos Gray sherd found associated with Emery Gray sherds.

Late Prehistoric/Protohistoric utilization of the area is indicated by a distinctive Shoshonean biface, a site containing post-contact glass beads and a campsite dated to ca. AD 1840 (110±50 BP). Sites containing large corner-notched points and Desert Side-Notched points also suggest utilization during this time span.

HISTORIC RESOURCES

Site Types

Historic site types, defined by functional attributes, were categorized as follows: 1) short-term habitation campsites, 2) limited activity areas, 3) structures, 4) a mine and 5) a railroad station. Four short-term habitation campsites were recorded. Limited activity areas included two trash scatters (containing glass, tin cans and other refuse), three railroad trash scatters (trash scatters similar to above but located adjacent to railroad beds), two tin can scatters and one glass bead scatter. Two structures (one homestead and one foundation), one humate mine and one railroad station (Whitehouse Station) were also recorded.

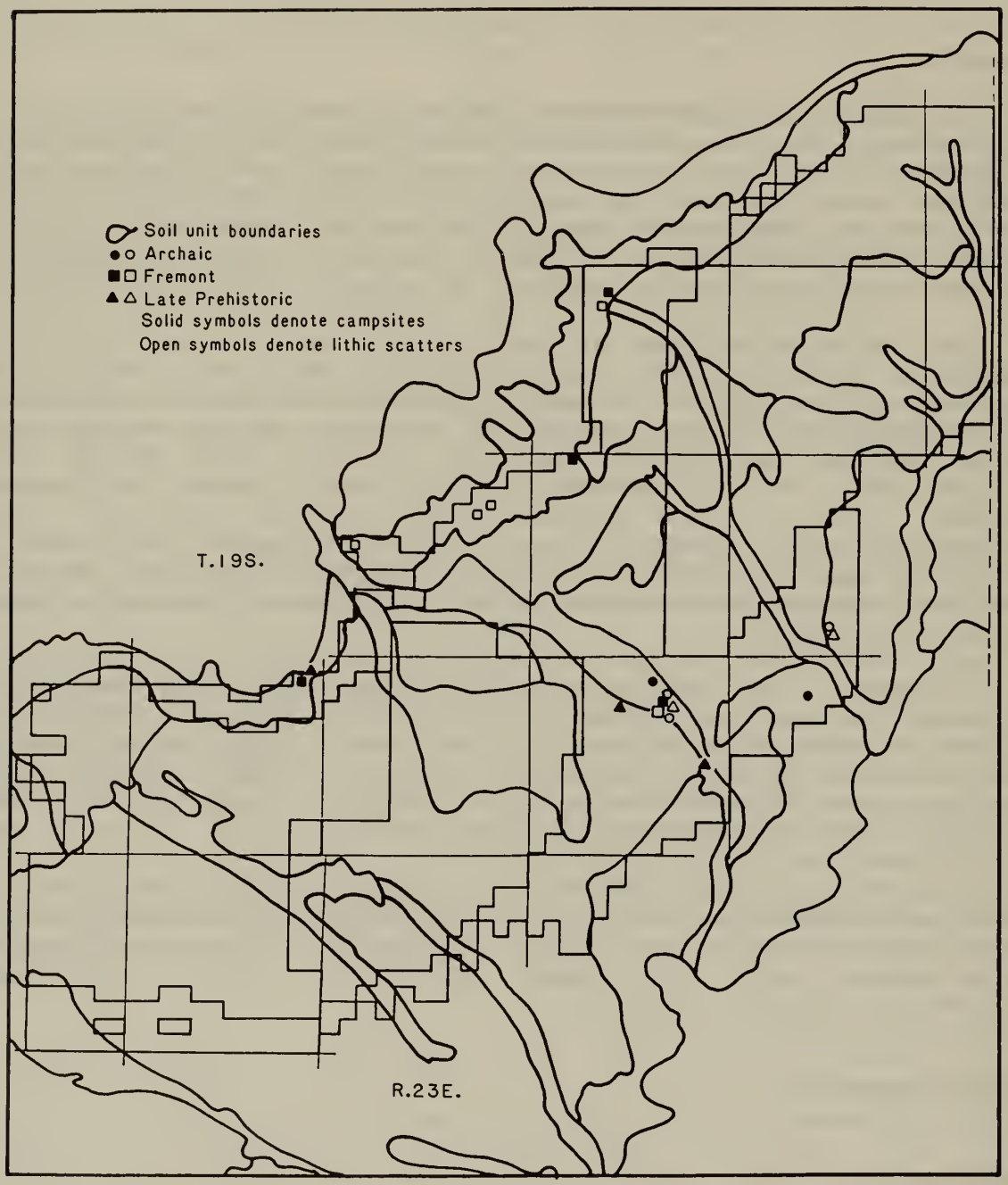


FIGURE 24. Cisco III Prehistoric Campsites and Lithic Scatters with Known Cultural Affiliations.

Material Culture

Historic artifacts include the following:

1) tin cans - solder-top and modern seamed; containers for food, tobacco, opium.

2) glass - bottles, window, insulator, lantern.

3) nails - modern common (wire).

4) ceramics - earthenware crocks, beverage containers, stoneware and porcelain, opium pipe.

5) leather - shoe fragments.

6) wire - baling and barbed.

7) ammunition - cartridges.

8) wood - milled lumber, railroad ties, cedar shake shingles.

9) other metal - license plate, sheet tin, Texaco sign, tin cup, bed frames, buckets, stove parts, railroad construction metal, railroad spikes, shovel, buckles, barrel stays, screws, coffee pot, various tools and hardware, footlocker, wagon parts, horseshoe, pressure gauge (Figure 25).

10) rubber - unidentified fragments.

11) other - shell buttons, glass trade beads, tobacco pipe, bricks.

Dating Historic Artifacts

Dating of the historic artifacts was based on technological and manufacturing data, and functional and physical attributes. Tin cans were dated according to size (condensed milk cans), type of manufacture (soldered hole-in-top or modern seam cans), and can contents and shape (tobacco cans, key-opened coffee cans, soda/soft drink cans). Glass bottles were dated by color and chemical content of the glass (purple, aqua, brown, black, dark green, clear), amount of patina, mode of manufacture (free blown, various mold types, semi-automatic machine, fully automatic machine), physical attributes (size, finish, neck, shoulder, body, base types), closures, embossing, manufacturers' marks and dates of operation, and labeling techniques. Window glass was dated by thickness, and dates for glass insulators were determined by manufacturer's marks and physical attributes (color, shape, presence of drip points, etc.). Nails were dated by manufacturing technique (square and wire nails) and ceramics by style, decoration, technology and hallmark. Barbed wire dates were established by the type of barb, number and twists of wires, patent and manufacturing dates. Cartridges were dated by the head stamp and manufacturer' dates of production. The majority of the additional artifacts such as bone, leather, wood, rubber and various metal objects were not specifically datable.

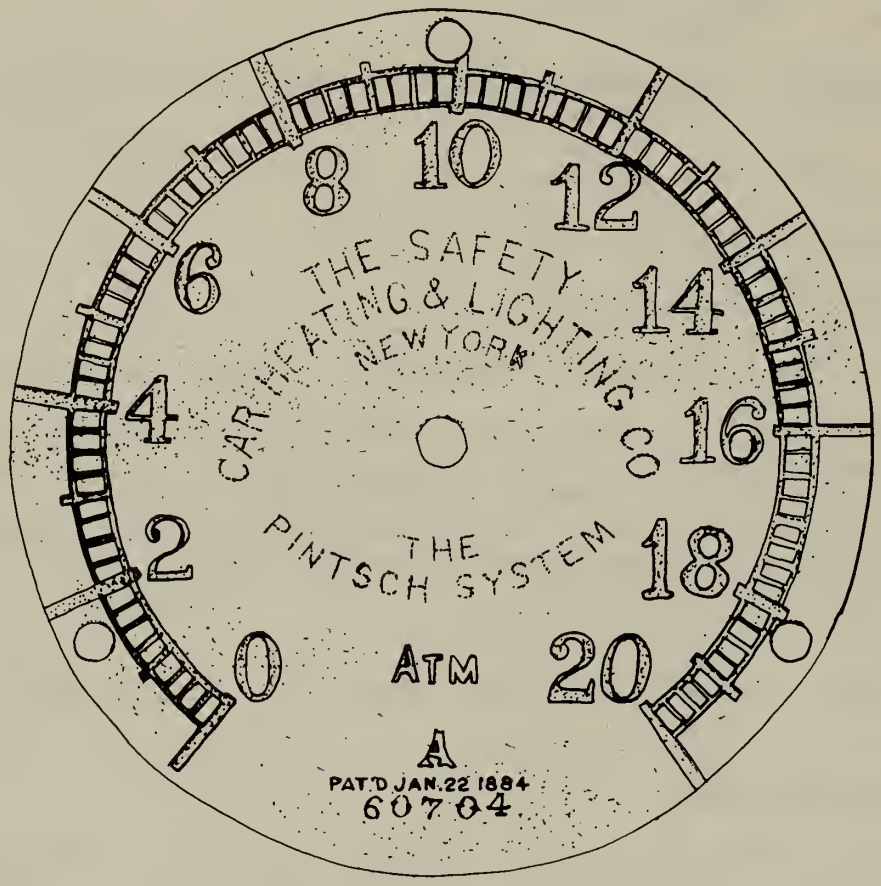


FIGURE 25. IF76. Circular Brass Pressure Gauge Faceplate. Drawing actual size.

Dating the Historic Sites

The following information is a brief description of the dates assigned to the historic sites based on the artifact analysis.

42GR1599 is a sheepherder's campsite containing glass, tin cans, nails, milled wood and other metal. Based on the presence of purple glass, the site may date as early as 1880-1920 (Fike 1984:personal communication). The predominance of solder-dot tin cans indicates a pre-1910 date (Fawcett 1979:1); aqua glass found at the site was commonly used pre-1930 (Firebaugh 1983:11); the size of the condensed milk cans supports a date of pre-1931 (Fawcett 1979:1); and the clear glass bottles can be dated post-1930 (Ibid.). This range of dates, from ca. 1880 to post-1930, indicates potential use of the site over a period of perhaps 50 or more years.

42GR1600 is a sheepherder's campsite containing a fragment of clear glass, tin cans, a sandstone hearth and milled wood. The existence of flat-sided, hinged tobacco cans implies a post-1910 date (Berge 1980:261); key-opened vacuum coffee cans are dated post-1928 (Fawcett 1979:1); and the condensed milk can size indicates a date of pre-1931 (Ibid.). Based on these artifacts the site was occupied in the late 1920s or very early 1930s.

42GR1601 is a sheepherder's campsite containing tin cans, a hearth and wood. Modern seamed tin cans outnumber hole-in-top cans, implying a post-1922 date (Fawcett 1979:1), and the condensed milk cans are dated pre-1931 (Ibid.). These dates indicate occupation of the site between 1922 and 1931.

42GR1602 is a trash scatter with glass and tin cans. A small percentage of the tin cans are solder-dot food cans and condensed milk cans which date pre-1931 (Fawcett 1979:1), however, the majority of the cans are non-soldered food cans and/or modern condensed milk cans. The artifacts appear to have been deposited from approximately the late 1920s to the 1930s.

42GR1621 is a humate strip mine with two depressions, the remains of a load-out and chute, tin cans, nails, other metal and milled wood. Datable artifacts include beverage cans without pull tabs dating 1950-1962 (Busch 1981:101) and a 1962 license plate. A modern 42-inch diameter Texaco sign is also on the site. Based on the artifactual remains, the site appears to date to the early 1960s.

42GR1640 is a tin can scatter containing one modern seamed can and eight solder-top cans with plugs. The predominance of solder-top over modern seamed cans implies a 1900-1910 date (Fawcett 1979:1).

42GR1641 is a tin can scatter containing four solder-top cans. Two are datable condensed milk cans (Fawcett 1979:1) and two are modern seamed cans (Busch 1981:98). These artifacts indicate a date range from the 1920s to the 1930s.

42GR1672 is a site containing 715 whole glass trade beads, commonly referred to as "pony beads", located in 4 ant hills. They were manufactured in Venice, Italy, with documented production beginning as early as AD 1490 (Francis n.d.), and continuing through the present (Richard Conn 1984:personal communication). Bead color and size varieties are presented in Tables 7 and 8. No structures or other artifacts were noted.

TABLE 7. 42GR1672. Bead Varieties Per Hill.

Color	Ant Hill# 1	2	3	4	Total
Light blue/green opaque and translucent	223	2	2	2	229
Bright blue opaque	163	1	7		171
Light green opaque and translucent	110	2			112
White opaque	63		1		64
Yellow opaque and translucent	48				48
Purple translucent (faceted)	36		1		37
Black	27				27
Green translucent	20				20
Light blue translucent	6				6
Red translucent	1				1
Total	697	5	11	2	715

TABLE 8. 42GR1672. Bead Varieties For Entire Site.

Color	Number	Percent	Size Range
Blues	406	56.78	.2 - .4 cm.
Greens	132	18.46	.25 - .45 cm.
White	64	8.95	.25 - .4 cm.
Yellow	48	6.71	.25 - .4 cm.
Purple	37	5.17	.3 - .4 cm.
Black	27	3.77	.25 - .5 cm.
Red	1	.13	.35 cm.
Total	715	99.97	

The beads were manufactured by dipping a wire in molten glass and drawing the glass until it cooled. This hollow glass tube was then cut into bead lengths. The edge-rounding was achieved by mixing the beads in a mixture of hot charcoal and fine sand, with the final polishing accomplished by agitating the beads in bags of bran (Kidd and Kidd 1970:49). The irregular facets of the purple beads were probably filed onto the glass tubes prior to cutting and polishing, as the edges of these beads are not nearly as rounded as the other colors. Additionally, while the majority of the beads were probably used for embroidery, the purple faceted beads were more often used on fringes and in necklaces (Richard Conn 1984:personal communication). Mr. Conn also stated that the larger size beads were popular among the Plains Indians through the 1840s, while this larger size was predominant in the Intermontane region through the 1870s. The blue beads were generally preferred, because it was a color the Native American technology was incapable of reproducing with the materials at hand.

The length of time these beads were manufactured, their durability and possibility of reuse, makes it difficult to assign a precise date to the site. It is likely that beads were introduced to the area on a large scale in the 1820s when trappers and traders entered the region (Athearn 1981:21). To the south, however, Indians had obtained beads at a much earlier date, presumably from the Spanish. Carlson (1965:92) documents 17 types and colors of beads that were recovered by Earl Morris from a fortified Navajo site in northwestern New Mexico. The site was dated to the late 17th/early 18th century, and the description of the beads was similar to this collection, especially the light green translucent type. To the north, Mr. Conn (1984:personal communication) theorizes that light green translucent

beads were traded extensively by the Northwest Trade Company in Canada prior to their takeover by the Hudson Bay Company. Although not fully substantiated, he believes trade of this particular bead, especially in Canada, practically came to a halt by the early 19th century. However, beads of this color, although smaller in size, were recovered from a Pawnee burial in Nebraska, dating 1857-1875 (Carlson 1973:40, 45). In fact, the vast majority of beads from this burial are smaller in size than those recovered from 42GR1627, perhaps substantiating the size preference discussed above.

It appears the most realistic date for site deposition falls between the 1820s and the 1880s, with possible overlap on both ends. Actual site type is difficult to assign, but the two most likely possibilities are a burial or the remains of a lost/discarded article of clothing or horse trappings.

42GR1674 is a historic structure/homestead with a four-room log house, corral, two sheds, privy, and well. Artifacts include purple and clear glass, tin cans, wire, nails, bone and wood. Four samples of barbed wire were collected and identified. One is Spilt Diamond (Early or Obvious), patented December 14, 1875 by Henry N. Frentress (McCallum 1965:246) and three are Bakers Barb (Needle-Point Variation), a probable variation of patent No. 273219 by George C. Baker, February 27, 1883 (Clifton 1970:90). Information obtained from a file search and informants establishes the site as the Erickson homestead, occupied ca. 1900-1920 during an attempt at dry-land farming.

42GR1677 is a historic railroad station located along a former and existing Denver & Rio Grande Western railroad line. The site, identified as Whitehouse Station, contains two wooden privies and wooden supports for a structure, probably part of the railroad station. A road at the east end of the site leads to a dump atop the ridge behind the station. Richard E. Fike (1983:personal communication) identified several separate surface concentrations of artifacts, one of which is an assemblage of Chinese materials including fragments of an oriental-designed ceramic cup, rice bowl, soy container, pieces of opium tins and pipes, and a Tiger Whiskey bottle cap, dating 1880-1890 (Munsey 1970:138). Two concentrations of artifacts are identified at dating to ca. 1940 (Fike 1983:personal communication). A sample of the other datable remains at the site includes purple glass; a brown bottle base manufactured by the Adolphus Busch Glass Manufacturing Co., 1904-1907 (Toulouse 1971:26); a brown bottle with a cork closure, dating to pre-1920 (Fawcett 1979:2); a white ceramic saucer fragment manufactured by the Smith-Phillips China Co., East Liverpool, Ohio, in the late 19th century (Thorn 1947:148); aqua glass; a brown beverage bottle fragment produced by the Buffalo Brewing Co., Sacramento, California, ca. 1910 (Munsey 1970:119); a large clear glass food bottle manufactured by the Owens-Illinois Co., 1929-1940 (Toulouse 1971:403); and a clear mayonnaise jar made by the Hazel-Atlas Glass Co., 1920-1964 (Toulouse 1971:239). The concentration of Chinese artifacts is probably representative of the earliest occupation of the site, most likely during construction of the Denver and Rio Grande Western Railroad, 1880-1883 (Athearn 1962:123). Other artifacts suggest later reuse of the site, probably as a dump, from the 1920s through at least the 1940s.

42GR1678 is a railroad trash scatter containing glass, tin cans, nails, other metal, bone, wood, ammunition and other refuse. Solder-dot tin cans are predominant. The 16 collected glass artifacts are primarily medicinal and alcoholic beverage bottles, e.g., Carl Conrad & Co., "Budweiser", 1876-1883 (Toulouse 1971:117,118) (Figure 26), and other probable beer, wine or champagne bottles. These glass items date from ca. 1880-1918 with the majority produced during the late 1800s to the very early 1900s. These dates indicate that the site may have been a railroad construction campsite, ca. 1880-1881 (Athearn 1962:123), associated with 42GR935, an abandoned narrow gauge railroad bed (Reed and Nickens 1980:38).

42GR1679 is a railroad trash scatter containing glass, tin cans, wire, nails, ceramics, and wood. The ceramics are fragments of Homer Laughlin Premium Stone China, East Liverpool, Ohio, manufactured from 1879-1897 (Berge 1980:178, 213). Several fragments of green glass, panelled medicine bottles date 1867-1915 (Firebaugh 1983:11). These artifact dates, ranging from the late 1800s to the early 1900s, suggest that the site materials may have been deposited during early railroad related activities, e.g., construction or maintenance of 42GR935 (Reed and Nickens 1980:38).

42GR1699 is a trash scatter consisting of 100+ cans and bottles, ceramics, window glass, and several metal objects. The artifacts represent a variety of domestic goods, e.g., food, soda, medicine, cosmetics (a purple glass perfume bottle, Figure 27a, b), alcoholic beverage containers, china, an iron handle fragment, and a possible engine part. The window glass dates post-1850 (Fawcett 1979:1), and two brown glass alcoholic beverage bottles are dated post-1900 and post-1903 (Fawcett 1979:1; Firebaugh 1983:15). The majority of the additional glass artifacts were manufactured by the Illinois Glass Co. from 1916-1929 (Figure 28 a b), and the Owens-Illinois Glass Co. from 1929-1940 (Toulouse 1971:264, 403) (Figure 29). One bottle dates 1930-1940 and another may date to ca. 1947 (Berge 1980:65,79; Toulouse 1971:292). Solder-dot tin cans are predominant. Dates for the site range from approximately the early 1900s to the 1940s. The materials may have been deposited continuously during that time span, or the site could have been reused periodically.

42GR1700 is a rectangular stone cobble foundation, a depression, and an associated trash scatter containing glass, tin cans, wire, nails, ceramics, bone, wood and other refuse. The majority of the tin cans are modern seamed. One clear glass "Lone Star Beer" bottle is dated post-1930 (Firebaugh 1983:27). The artifacts indicated a date range of 1920-1930s for occupation of the site.

42GR1714 is a prehistoric lithic scatter of indeterminate age, with an overlying historic component. The historic campsite contains purple glass, tin cans, a hearth, wood, and ammunition. Solder-dot tin cans predominate at a ratio of 2:1 over modern seamed cans. A Winchester Repeating Arms Co. .38 Smith and Wesson Special cartridge dates post-1940 (Ibid.:2). These artifacts, ranging in date 1880 to post-1940, indicate potential use of the site over a period of 40-60 years.

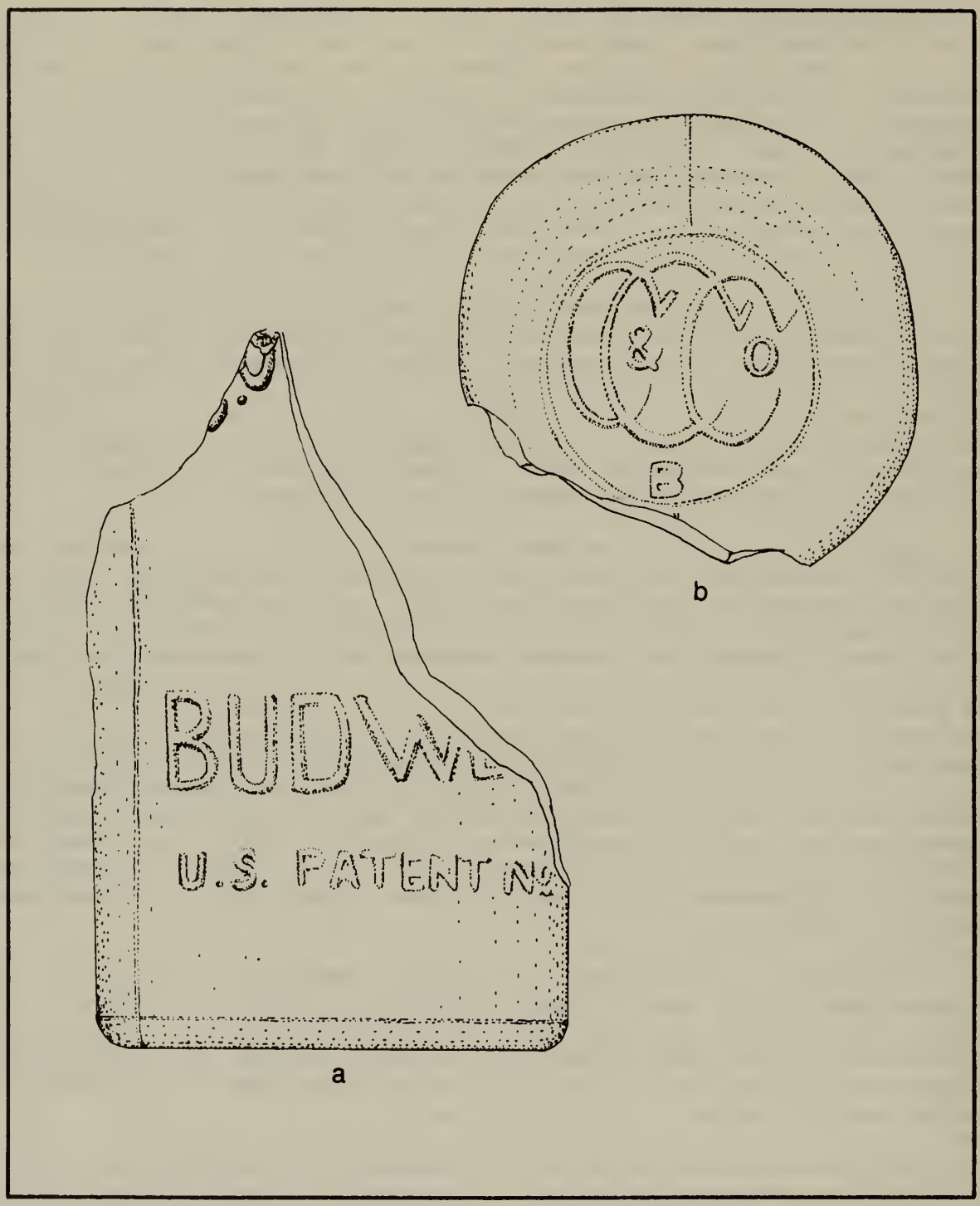


FIGURE 26. 42GR1678.4. a) side view "BUDWEISER" beer bottle and b) bottom view "CC&CO" embossed, Carl Conrad & Co., 1876-1883 (Toulouse 1971:117, 118). Drawings actual size.

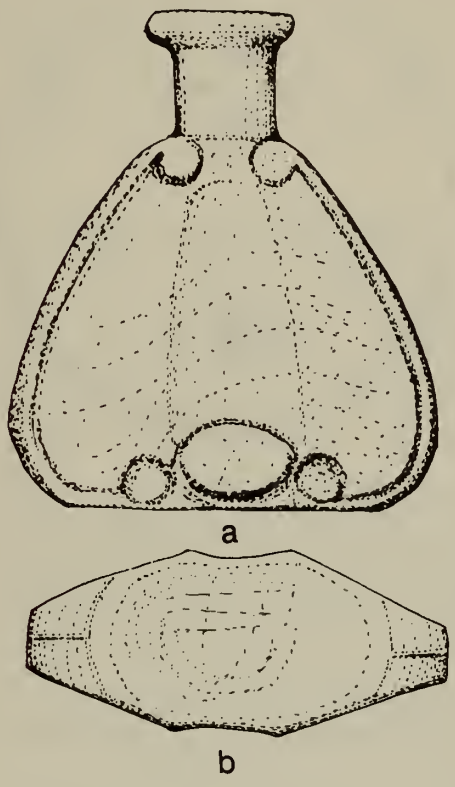


FIGURE 27. (above)
42GR1699.27. a) side view, purple glass perfume bottle ca. 1880-1920 (Fike 1984: personal communication)
b) bottom view.

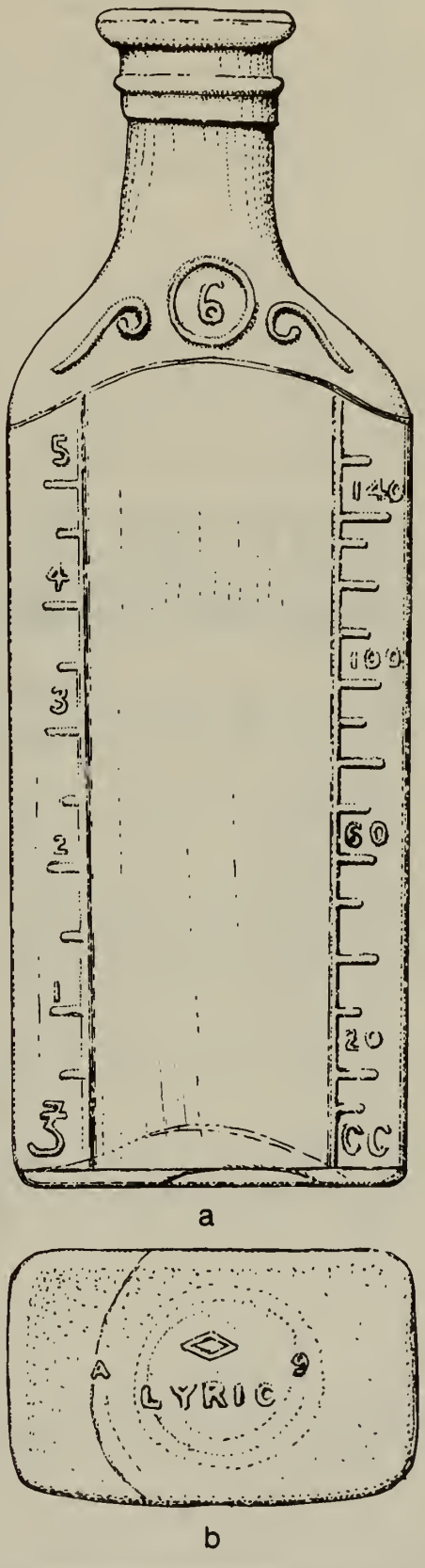
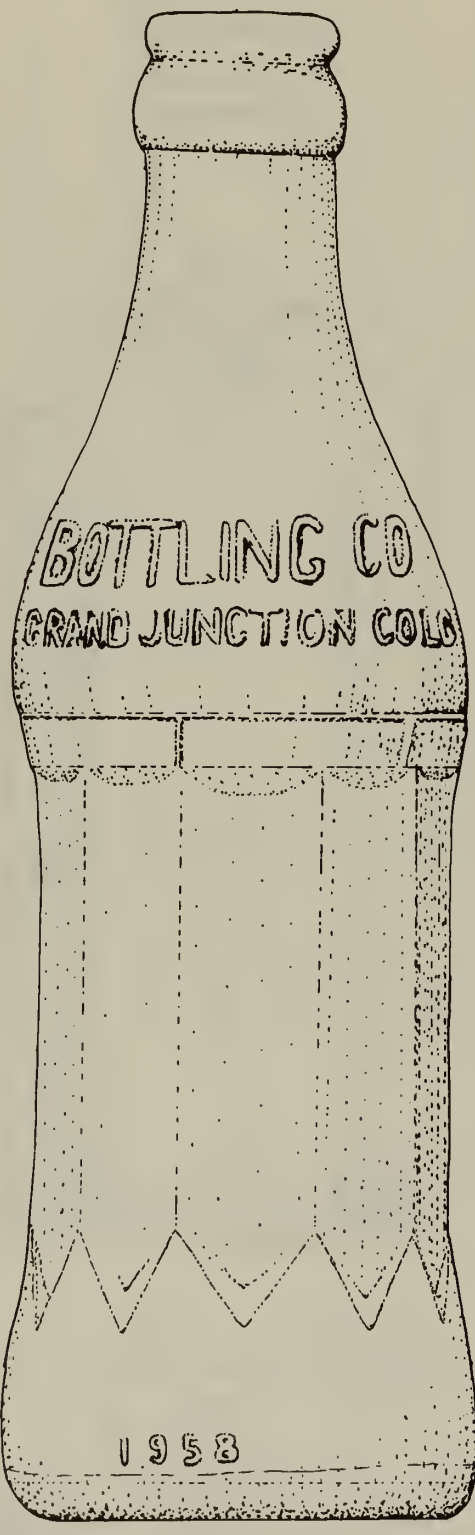
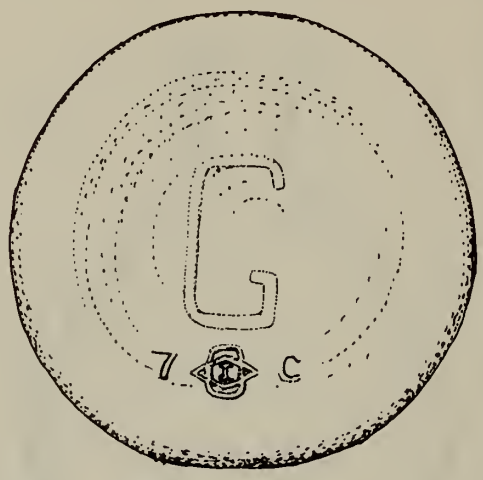


FIGURE 28. (on right)
42GR1699.19.
a) side view, clear glass medicine bottle unthreaded finish, embossed volume amounts b) bottom view, maker's mark, Illinois Glass Co., Alton, Illinois, 1916-1929 (Toulouse 1971:264).
Drawings actual size.



a



b

FIGURE 29. 42GR1699.5. a) side view, clear glass soda bottle, 6.5 oz., ten-sided, Crown top finish. "GRAND JUNCTION BOTTLING CO., GRAND JUNCTION, COLO." b) bottom view, maker's mark of the Owens Illinois Glass Co., Toledo, Ohio, 1929-1940.

42GR1726 is a railroad trash scatter containing glass, tin cans, and a hearth. Purple glass and fragments of a brown glass bottle with a cork closure are present. Another brown glass bottle exhibits an applied top, ca. 1850-1918 (Firebaugh 1983:20). Solder-top tin cans are predominant. These artifacts suggest that the site materials were deposited during the late 1800s to the early 1900s. The site may have been related to construction of 42GR935 (Reed and Nickens 1980:38), 1880-1883 (Athearn 1962:123).

NATIONAL REGISTER CONSIDERATIONS

To aid in land management activities, this contract required statements of significance (recommendations of site's eligibility to the National Register of Historic Places) to be offered. Specific guidelines for these recommendations are set forth by the Federal government at 36 CFR 60.4 of the U.S. Government Code of Federal Regulations, and are as follows:

> The quality of significance in American history, architecture, archaeology, and culture is present in district, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association; and
>
> a) that are associated with events that have made a significant contribution to the broad patterns of our history, or
>
> b) that are associated with the lives of persons significant in our past; or
>
> c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> d) that have yielded, or may be likely to yield information important in prehistory or history.

Recommendations of significance, however, remain subjective judgments made from comparative information in and around the study area. Different recommendations may be offered depending on the archaeologist consulted and the area under consideration.

When recommending lithic sites as eligible, the criterion most often used is (d), to provide for the possibility that a site may contain significant subsurface components. Subsurface potential becomes an important consideration in this area when examining the results of past surveys. The Cisco Desert, in general, was a demonstrated low site density area (Reed and Nickens 1980:53) and as such, has had little work done to provide stratigraphic control for the archaeological resources. Sites located in topographic/geologic situations favoring subsurface potential, i.e., sand dunes, alluvial plains, should then be considered eligible in that they may provide needed stratigraphic and temporal control to further

the understanding of aboriginal occupation/utilization of these marginal areas.

In the case of this study, criterion (c) is also used to provide for those resources located in high site density areas. Resources considered under this criterion may not be significant when evaluated alone, but become significant when viewed in the larger context of an archaeological district.

The following discussion summarizes eligibility recommendations for the 126 recorded sites. The number of prehistoric sites recorded necessitates group description rather than individual statements of significance. Prehistoric resources will be addressed first, followed by historic resources.

Eligible Prehistoric Resources

A total of 91 aboriginal sites is considered eligible for nomination to the NRHP, 63 as part of 2 archaeological districts and 28 on their own merit (Figure 13). While all 63 "district sites" are not significant in and of themselves, all are eligible under criteria (c) and (d), in that they "represent a significant and distinguishable entity whose components may lack individual distinction" and "may be likely to yield information important in prehistory." The 28 sites considered significant on their own merit either demonstrated or possess a high likelihood of containing subsurface cultural deposits and, therefore, are recommended as eligible under criterion (d).

Forty-seven sites (Appendix 2) lie in the greasewood/desert shrub vegetation community on the alluvial plain to either side of Cottonwood Wash, and are included as part of the proposed Cottonwood Archaeological District (Figure 13). Cottonwood Wash is the only regularly flowing body of water in the Cisco Desert, and based on site density along the drainage (27 sites per square mile), appears to have been a major travel corridor between the Colorado River and the Book Cliffs, as well as a destination for resource procurement. The sites contain a wide range of artifact types and therefore imply a variety of potential functions. Thirty-two are campsites with groundstone or fire cracked/oxidized rock and eighteen are lithic scatters, one is a rock shelter, and one is a quarry (Figure 15). Sites containing temporally or culturally diagnostic artifacts indicate Archaic, Formative (Fremont) and Late Prehistoric utilization of the area (Figure 24).

The proposed Westwater Archaeological District contains 16 sites (Appendix 2) and is located in the uplands south of the Cisco Desert (Figure 13). The vegetation community is primarily juniper with a few sites located in sand dune or desert shrub microenvironments. The sites in the proposed district contain essentially similar tool kits compared to those in the proposed Cottonwood District. Three rockshelters, e.g., 42GR1661 (Figure 30), and three campsites were recorded in the Westwater District and ten sites, lacking the requisite groundstone or evidence of a hearth, were classified as lithic scatters (Figure 15). Temporally diagnostic artifacts indicate Archaic and Late Prehistoric use of this area. Diagnostic

FIGURE 30. 42GR1661. Rockshelter, facing east.

Formative (Fremont) artifacts were not recorded in this area. Groundstone artifacts and point types, including large and medium corner-notched and Pinto varieties, suggest Early Archaic and later utilization (Figure 24). Several sites have been previously recorded in this area during humate mine surveys (cf. Lee and Clements 1981) and these, though not noted on forms accompanying this project, also fall within the proposed district.

Not Eligible

The remaining 20 aboriginal sites (Appendix 2) are not considered eligible for nomination to the NRHP. This total includes one site (42GR1714) containing both a prehistoric and historic component. Neither component is considered eligible. In addition, the 103 prehistoric isolated finds recorded are considered ineligible. These resources are neither distinctive in character, nor do they appear to possess subsurface cultural material. As such, there is little likelihood they would yield additional significant data.

Eligible Historic Resources

Eligibility requirements for historic sites are similar to those for prehistoric sites in that they must meet one or more of the criteria set forth at 36 CFR 60.4. Six of the fifteen historic sites recorded during this study are recommended as eligible for nomination under criterion (c) and/or (d) (Figure 14) (Appendix 3). Sites 42GR1678, 42GR1679 and 42GR1726 are eligible as part of the narrow-gauge railroad system, 42GR935, recorded previously in the survey area (Reed and Nickens 1980:38). These sites, when considered alone, do not appear to be eligible for the National Register, however, they may provide data useful for future research of the narrow-gauge railroad construction. Site 42GR1674, the Erickson Homestead, is significant in that its method of construction and integrity may provide important information on 1920s lifestyle in the area. These three sites are eligible under criteria (c) and (d) while sites 42GR1672 (the bead site) and 42GR1677 (Whitehouse Station) are eligible under criterion (d). The latter two sites have demonstrated subsurface material, and may yield further information important to the history of the region.

Not Eligible

The remaining nine historic sites, the historic component of 42GR1714 and 25 historic isolated finds are principally tin can scatters or isolated artifacts that can provide little additional information for understanding the area. All are considered insignificant and not eligible for nomination to the NRHP.

Discussion

Relatively accurate dates may be assigned to the historic resources found during this project by using temporal indicators such as bottles, cans and other diagnostics. Due to these dates, recommendations of eligibility were more objective than those offered for the prehistoric sites. Six sites

are recommended as eligible for nomination and ten sites, lacking potential to yield further important information, are recommended as not eligible. In addition, the 25 historic isolated finds have been fully recorded and are not eligible for inclusion in the NRHP.

Management Recommendations

A blanket statement such as "eligible vs. not eligible for nomination to the NRHP" provides little information to the sponsoring agency concerning the management direction recommended for cultural resources under consideration. Therefore, the sites found during the Cisco III study have been further evaluated in three management categories, designated simply as Categories 1, 2, and 3. Assignment of sites to these categories is intended to provide the BLM with a workable management plan in addition to recommendations of site eligibility.

Category 1 recommendations identify resources that are eligible for nomination to the NRHP based on: 1) high surficial artifact density of various flaking stages and/or, 2) demonstrated or probable subsurface deposition as indicated by the site's location on a dune or alluvial plain. Sites in this category should be avoided by allowing a buffer zone of at least 150 feet from the site boundary when construction or other land disturbing activity is being undertaken in the vicinity. If avoidance is not feasible, a data recovery plan is the preferred alternative.

Category 2 recommendations identify resources that: 1) are not significant on their own merit, but are significant when considered in the context of an associated high site density area, 2) exhibit high surface artifact density or, 3) possess the potential for subsurface cultural deposits based on surface indications. Sites in this category should be treated as potentially eligible and should be extensively mapped, surface collected and tested prior to any land disturbing activity. If these mitigation measures prove unfeasible, a buffer zone of no less than 150 feet should be maintained between the site boundary and impact area. In addition, when construction is planned near any sites within the proposed Cottonwood or Westwater Archaeological Districts, the activities should be monitored by a professional archaeologist. Sites are not always visible on the surface, and in these high site density areas, the possibility of encountering subsurface material is extremely high.

Category 3 recommendations identify resources that have been fully recorded and, based on surface indications, have little potential for depth of cultural deposits. Construction may be undertaken in the vicinity of these sites without additional prior archaeological consideration. A note of caution must be inserted here that if subsurface cultural material is encountered, work should be halted and the BLM archaeologist notified immediately.

Table 9 summarizes the management recommendations for the 126 sites recorded during this project.

TABLE 9. Management Recommendations Summary.

Category	Site Numbers
1	42GR - 1606, 1607, 1608, 1611, 1612, 1615, 1618, 1623, 1625, 1627, 1628, 1629, 1631, 1632, 1633, 1634, 1635, 1636, 1637, 1638, 1639, 1642, 1643, 1644, 1645, 1653, 1655, 1656, 1657, 1658, 1661, 1664, 1667, 1668, 1672, 1673, 1674, 1676, 1677, 1680, 1682, 1686, 1687, 1688, 1689, 1692, 1694, 1696, 1697, 1702, 1706, 1712, 1720, 1723, 1725, 1732, 1733
2	42GR - 1605, 1609, 1613, 1614, 1616, 1617, 1619, 1620, 1622, 1624, 1626, 1630, 1662, 1663, 1665, 1666, 1669, 1670, 1671, 1678, 1679, 1681, 1690, 1691, 1693, 1695, 1698, 1701, 1703, 1708, 1709, 1715, 1717, 1718, 1719, 1721, 1722, 1724, 1726, 1734
3	42GR - 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1610, 1621, 1640, 1642, 1646, 1654, 1659, 1660, 1675, 1683, 1684, 1685, 1699, 1700, 1704, 1705, 1707, 1710, 1711, 1713, 1714, 1716

CHAPTER V

PREDICTIVE MODELING

ORIGINAL 10% MODEL

As originally planned, the contract required building a predictive model for prehistoric site locations, using previously collected site and environmental data from the Cisco Gas and Oil Field area. Although numerous small surveys had been conducted in the area, Reed and Nickens (1980) Class II sample surveys of the adjacent Danish Flat-Windy Mesa study tract in 1978 and Nash Wash and Stateline study tracts in 1979 were used for the data base. This allowed continuity of sampling fraction (10%), sample unit size (40-acre 1/2 mile by 1/8 mile transects) and site definition (five or more artifacts) during the building and testing phases, as well as provided additional data for a contiguous area of over 200,000 acres. Their work also provided environmental data for the sample units enabling model construction and testing of "strata" previously identified as important to site and nonsite locations. The model would, if necessary, be refined to an 80% accuracy rate during the testing phase using survey data collected at a 1%, 5% and finally, 10% sampling fraction of the 80,000 acre 1983 study area. The general objective of the project was the identification of environmental variables important for accurately predicting prehistoric site locations with an emphasis on delineating those areas of low site density. Previous surveys in the Cisco Desert had encountered extremely low site density in the Mancos Shale/desert shrub areas and it was assumed that the present study would produce similar results. Refinement of the model to an 80% level of accuracy would aid in the future management of the entire 200,000 acre Cisco Oil and Gas Field area.

Reed and Nickens (1980) presented and partially tested hypotheses regarding the extremely low site density areas and these hypotheses would be further tested and expanded with the additional data base. They hypothesized that the "low" site density (.38 sites per square mile), "medium" site density (2.55 sites per square mile) and "high" site density (9.6 sites per square mile) areas were the result of differential distribution of resources in the region. In the low site density areas (desert shrub stratum) and the medium site density areas (drainage stratum) that dominated most of the 1978-79 project areas, the general scarcity of critical resources was thought to be responsible. They hypothesized that these areas were probably used as thoroughfares for specific resource gathering, with the larger more permanent sites being located to the north near the Book Cliffs and the juniper covered ridges at their base, and to the south and southwest along the Colorado River. These high site density areas (juniper/sage stratum) were the result of the more diverse environmental resources that occurred there.

These strata were to be further expanded or modified and, if possible, their boundaries more accurately determined. Site and nonsite locational data would then be analyzed relative to these corrected boundaries using a multivariate discriminate analysis computer program. Additional

environmental variables found to be important in predictive modeling attempts in similar environments would also be included in the analysis.

Research Design

Laboratory methodology consisted of a discriminant analysis technique (Nie et al. 1975) patterned after successful modeling attempts by Kvamme (1980) in the Glenwood Springs Resource Area of western Colorado, and Larralde and Chandler (1981) in the Uinta Basin of northeastern Utah. Environmental variables important to site and nonsite locations in these areas were encoded for all 38 prehistoric sites encountered during Reed and Nickens (1980) surveys of 352 randomly sampled 40-acre transects. Fifty-seven of their negative 40-acre transects were randomly selected and their center points used for the nonsite measurements.

Generalized BLM vegetation designations had been problematic in the 1978 and 1979 study areas necessitating adjustments of the proportionately stratified sampling designs during fieldwork. Also, a number of sand dune sites had been recorded along the western edge of Cottonwood Wash in the 1983 project area (Babcock 1981) and their distribution relative to the previously defined strata was unknown. In order to more accurately determine vegetation boundaries for the 1983 project areas, and possibly identify the sand dune localities, a spectral quality analysis was conducted on a microcomputer at the Geography Department, University of Colorado, using LANDSAT multidate computer compatible tapes acquired from the BLM in Denver. Due to the low reflectance of the vegetation in the desert shrub areas, the analysis was only partially successful. It was decided to use a simple random sample rather than a predetermined proportionately stratified sample based on the available vegetation data. Larralde and Chandler's (1981:141) work analyzing sand dune localities in the Uinta Basin also supported a random sample scheme. If possible, stratification of the project area would be determined after the field test of the model, using environmental variables selected as important by the multivariate analysis and the additional environmental data recorded during the survey.

In the initial analysis of important discriminating variables in the previous 1978 and 1979 project areas, 15 variables (Table 10) were measured. All variable measurements were interval in scale, with distance measured to the nearest ten meters on 7.5 minute USGS topographic maps and BLM mylar vegetation overlays. Elevation, slope, exposure, view and relief measurements were determined using 7.5 minute topographic map contour lines following Kvamme (1982). Nearest primary water included the Colorado River, Cottonwood, Sagers, Nash, Cisco, Danish and Pinto Washes and Westwater, Sulphur and Bitter Creeks.

Each data set was analyzed at .05, .10, and unrestricted levels of confidence. For stepwise inclusion into the final model, the .05 confidence level was chosen as the required significance level. The less restricted levels were included in order to determine if any additional variables were important and what effect these would have on classification accuracy.

TABLE 10. Variables Coded for the 10% Model.

VARIABLE	DESCRIPTION
HDPH2O	Horizontal distance to nearest primary water
VDPH2O	Vertical distance to nearest primary water
HDNBD	Horizontal distance to nearest named blueline drainage
VDNBD	Vertical distance to nearest named blueline drainage
* VANTAGE	Horizontal distance to nearest vantage point
JUNIPER	Distance to nearest juniper community
SAGE	Distance to nearest sage community
GRASS	Distance to nearest grass community
GREASEW	Distance to nearest greasewood community
DESHRUB	Distance to nearest desert shrub community
ELEV	Site elevation (ft.)
* SLOPE	Percent grade using USGS topographic map contour lines
* EXPOSURE	Prominent slope direction with 0° indicating north, 90° east or west and 180° south
* VIEW-SPREAD	Downhill view angle (0 - 360°)
* RELIEF	Relief within a 500 meter radius using map contour lines

* Adapted from Larralde and Chandler (1981) and Kvamme (1980).

Table 11 shows the canonical discriminant function coefficients (CDFC) and associated site and nonsite group means for the original 10% prehistoric model at the .05 confidence limit (Data Set 1). The variables selected represent important discriminators between the site and nonsite locations. When the sign is ignored, each standardized CDFC "represents the relative contribution of its associated variable to that function" (Nie et al. 1975:443). For example, elevation, viewspread, distance to a vantage point and slope were selected, in this order of importance, as variables discriminating between prehistoric site and nonsite locations. While viewspread, distance to vantage and slope contribute equally to the function, with coefficients of approximately .40, elevation with a coefficient of .88 is roughly twice as important as each of these.

An examination of the site and nonsite group means (Table 11), indicates that, in general, prehistoric sites are higher in elevation, have a narrower viewspread, are on gentler slopes and are closer to points of vantage than are the nonsites. Separate analysis of the prehistoric site types was not possible due to the small number of campsites found during the 1978-79 field seasons, however, the discriminating variables indicate that the prehistoric sites, in general, are located in those areas described by Reed and Nickens (1980), i.e., on gentle slopes nearer the Book Cliffs and the juniper ridges near their base. Nonsite, on the other hand, tend to be farther from the Book Cliffs and vantage points, on steeper slopes, and located in lower, more open terrain.

Classification accuracy results for Data Set 1 are depicted in Table 12. Highest site classification accuracy is 87% at the .05 confidence level. Associated nonsite classification accuracy is 83% resulting in an overall accuracy of 84%. Highest nonsite classification accuracy is 91% at the .10 and unrestricted confidence levels. Associated site classification accuracy, however, is lower at 84% for an overall accuracy of 88%. Distance to sage and desert shrub plant communities were selected as additional discriminators at the .10 confidence level. Since it is preferable to misclassify nonsites rather than sites, the .05 confidence level was used.

Field Testing the 10% Model

After only 40 transects had been surveyed (2% of the study tract), projected site density throughout the project area was much higher than that found in the adjacent study tracts surveyed by Reed and Nickens (1980). The most dramatic difference was along the drainage corridors where Reed and Nickens (Ibid:53) predicted a site density of 2.55 sites per square mile. Project results, to this point, indicated 24 sites in 8 transects or 48 sites per square mile; 29 times higher than the previous study. Site densities in the other two strata were also substantially higher by comparison, with four times as many sites predicted in the juniper/sage stratum and twelve times as many in the desert shrub stratum. Apparently, prehistoric occupation of the newly expanded Cisco Cultural Resource Study Area was concentrated along the lower Cottonwood Wash and Westwater Creek drainages and in the juniper areas near the river cliffs to the southeast.

TABLE 11. Canonical Discriminant Function Coefficients and Associated Group Means for Original 10% Prehistoric Model.

DATA SET 1 PREHISTORIC SITES			
Variables	Stand. CDFC	Group Means (Nonsite) Site	*Unstand. CDFC
Elevation	-.88465	(4829.30) ft. 5243.63 ft.	-.00356
View Spread	.44071	(175.18) Degrees 148.08 Degrees	.00598
Dist. to Vantage	.40896	(1.19) Km. .67 Km.	.60287
Slope	.37523	(7.02) % 4.37 %	.08464
		(constant)	15.69235
* All unstandardized values have been rounded to five decimal places.			

TABLE 12. Classification Accuracy in % for Original 10% Prehistoric Model.

DATA SET 1 PREHISTORIC SITES			
Confidence Level	Nonsites	Sites	Overall
.05	83	87	84
.10	91	84	88
unrestricted	91	84	88

At this point, it was realized that the parameters were completely different than originally assumed by the BLM when preparing the Scope of Work. The Contracting Officer's Representative (Bruce Louthan) was contacted and informed of the results and the density projections. It was mutually agreed that major revisions in the research design and sampling strategy would be necessary. Choices included a reduction of the sample size, a constriction of the project area or a substantial increase in the contract amount and continuance of the sampling as planned. After much discussion and onsite field inspection, the contract was modified, resulting in what came to be known as "The 5% solution".

BUILDING THE 5% MODELS

It was decided that the most prudent and feasible alternative would be to reduce the sample size to 5% of the original 80,000 acre study area. While this would not be directly comparable to the previous 10% samples, it allowed the majority of the Cisco Oil and Gas Field to be included in a sample survey. The site density projection for 4,000 acres (100 transects) was approximately 125 sites, which would provide an adequate sample for building a model for site locations. The contract was modified to allow for the preparation and testing of a new model, due to the differences of sample size, environment and site densities. The first 100 transects originally selected from the random number table were used to delineate the 4,000 acres for inclusion in the 5% sample. This selection process included 23 of the already surveyed transects. Data collected from the remaining 17 transects were not used in model building, but were used to independently test the predictive accuracy of the 5% model.

The data collected during the initial survey were analyzed with the aid of the 7.5 minute acetate overlay soil maps initially used in the remote sensing analysis. Sites misclassified by the 10% model seemed to correlate well with specific soil units. For example, sand dune sites were consistently associated with soil unit 3 (minor soil unit 61). This encouraged the building of two separate 5% models; one using the traditional variables and another based strictly on major and minor soil units. The advantages of the soil data included not only a finer breakdown of the environmental units of interest, i.e., drainages, juniper and desert shrub areas, but also included information on slope, elevation, landform and fauna. Used in conjunction with the traditionally important variables, it was believed that the soil model would accurately predict site and nonsite locations. If so, a ready-made site density and sensitivity map, at a 7.5 minute scale, would be available for use by BLM cultural resource managers.

Some changes in the traditional variables to be coded were made from the ones used in building the original model. Exposure and relief were deleted from the variables measured. These variables did not appear as significant discriminators at any confidence level in the original model. Horizontal and vertical distance to the Colorado River were added as variables, in that the high site density areas were generally closer to the Colorado River than the previously surveyed areas.

The soils model was constructed using the soil overlays and USGS topographic maps. Six of the twelve general soil units were found in the

project area, each containing numerous subunits designated by field symbols (Table 13). All sites recorded in the 1983 project area were located in five of these six general soil units and they were used as variables to discriminate between site and nonsite locations. Distance to the nearest soil subunit for each of the five general soil groups was then encoded for each site and nonsite. An additional variable, "X" (sandstone cliffs), was encoded to include actual and potential rock shelter locations along the base of the Book Cliffs and river cliffs.

The traditional and soils variables were coded for use in model construction using 88 prehistoric sites (40 lithic scatters and 48 campsites) and 51 nonsite points. Data from 13 historic sites were initially encoded, however, classification accuracy for all sites combined was low and no further analyses were performed using the historic sites. The nonsite data were measured from the center point of the surveyed transects containing no recorded prehistoric or historic sites. Recorded isolated find locations were not encoded, and were not used to reject a nonsite transect from the model. Data collected from the 17 surveyed transects not in the 5% model were used as an independent test.

Several models or separate discriminant analyses were prepared once the data were encoded. Lithic scatters and prehistoric campsites were analyzed separately for both traditional and soil variables. All computer analyses were run at .05, .10 and unrestricted confidence levels for comparative purposes (Table 14). Since the classification accuracy ranked at or above the required 80% for all Data Sets at all confidence levels, only the highest, most conservative level (.05) was used in all subsequent analyses and model tests.

Table 15 summarizes the important discriminating variables for lithic scatters (Data Set 2A) and campsites (Data Set 2B). The model indicates that seven variables were significant in discriminating lithic scatters from nonsites and four variables were significant in discriminating campsites from nonsites. As in the 10% model, the standardized canonical discriminant function coefficients (CDFC) indicate the relative importance of each environmental variable, if the negative signs in front of the values are ignored. Therefore, the variables in each data set are listed according to their relative importance as discriminators. For example, in Data Set 2A-Lithic Scatters, distance to vantage is approximately twice as significant as slope. Variables not listed proved to have no value for increasing the classification accuracy of the model. The unstandardized CDFC values are raw data, to be used in the formula when testing the model's predictive capabilities.

The group means are shown in Table 15 to indicate the actual difference between the site and nonsite groups for each significant variable. For example, in Data Set 2A-Lithic Scatters, the sites average approximately one half the distance to a vantage point as compared to the nonsites.

Table 16 ranks the significant discriminating soil variables in the same fashion as the traditional variables were ranked in Table 15. Of the five general soil units used in model construction, only #2 (Mancos Shale Lowlands) was not a significant discriminator in either Data Set 3A-Lithic

TABLE 13. General Soils Units and Corresponding Field Symbols.

General Soil Unit	Field Symbols for 7.5 minute Orthophotoquads overlays (Cisco III)
1	1, 2, 10, 38, 39, 40, 60
2	1, 2, 3, 4, 5, 6, 8, 10, 16, 19, 20, 29, 44, 60, 66, 140, 405
3	3, 8, 34, 61
5	11, 14, 16, 17, 22, 24, 27, 33, 35, 72
8	6, 16, 100, 105, 134, 163, 170, 315, 351, 400, 412, 413, 415, 422, 425, 431, 451
9	6, 16, 126, 140, 141, 422, 431

TABLE 14. Classification Accuracy in % for Traditional and Soil Variables.

Site Types and variables	Confidence Level	Nonsites	Sites	Overall
Data Set 2a Lithic Scatters - traditional	.05	88	87	88
	.10	88	90	84
	unres.	86	92	89
Data Set 2b Campsites - traditional	.05	92	85	89
	.10	88	83	86
	unres.	88	81	85
Data Set 3a Lithic Scatters - soils	.05	92	80	87
	.10	92	80	87
	unres.	92	80	87
Data Set 3b Campsites - soils	.05	90	81	86
	.10	90	81	86
	unres.	90	81	86

TABLE 15. Canonical Discriminant Function Coefficients and Associated Group Means for Traditional Variables at the .05 Confidence Level.

VARIABLES	STAND. CDFC	GROUP MEANS (NONSITE) / SITE	*UNSTAND. CDFC
DATA SET 2A-LITHIC SCATTERS			
Distance to:			
Vantage	.65619	(1.58) Km. / .80 Km.	.69919
Other H20 (Vertical)	-.58951	(28.14) Ft. / 71.43 Ft.	-.00860
Sage	-.53873	(6.19) Km. / 8.48 Km.	-.11784
Greasewood	.48776	(.73) Km. / .58 Km.	.64549
Desert Shrub	-.46507	(.04) Km. / .26 Km.	-2.31150
Colorado River	.43195	(16.54) Km. / 9.31 Km.	.06679
Slope	.34015	(6.22) % / 4.20 %	.06092
		(Constant)	-9.3391
DATA SET 2B-CAMPSITES			
Distance to:			
Desert Shrub	-.59438	(.04) Km. / .33 Km.	-2.73982
Colorado River (Vertical)	.53262	(530.40) Ft. / 355.21 Ft.	.00274
Primary H20	.50457	(3.80) Km. / 1.13 Km.	.22289
Other H20 (Vertical)	-.35045	(28.14) Ft. / 51.30 Ft.	-.00381
		(Constant)	-1.13152

* All unstandardized values have been rounded to five decimal places.

TABLE 16. Canonical Discriminant Function Coefficients and Associated Group Means for Soil Variables at the .05 Confidence Level.

VARIABLES	STAND. CDFC	GROUP MEANS (NONSITE) SITE	*UNSTAND. CDFC
DATA SET 3A-LITHIC SCATTERS			
Distance to:			
#8	.67802	(3.38) Km. 1.34 Km.	.26393
#3	.64861	(.98) Km. .58 Km.	.65396
#1	-.51169	(2.19) Km. 5.15 Km.	-.20966
#5	.49998	(10.61) Km. 4.14 Km.	.08634
		(Constant)	-1.12801
DATA SET 3B-CAMPSITES			
Distance to:			
#8	1.89576	(3.38) Km. 1.81 Km.	.76307
X	-1.42639	(3.16) Km. 2.44 Km.	-.59481
#3	.59019	(.98) Km. .40 Km.	.63770
#5	.54174	(10.61) Km. 5.08 Km.	.09590
#1	-.45471	(2.12) Km. 4.04 Km.	-.18790
		(Constant)	-.95486

* All unstandardized values have been rounded to five decimal places.

Scatters or Data Set 3B-Campsites. This soil unit has been identified as having the lowest site density in the project area.

Inclusion of one additional landform variable (designated as X) proved fortuitous in that it is the second most significant discriminator in Data Landform Set 3B. The significance of this discriminator is that Unit X is comprised of steep cliffs; prime areas for rockshelter locations.

Testing the 5% Models

Independent tests were performed on all four Data Sets. These tests used data collected during the Cisco III project as well as data recorded by Reed and Nickens (1980) during their surveys of 1978 and 1979.

Data Set 2A-Lithic Scatters-Traditional Variables

Discriminant scores for 11 lithic scatters not used in building the 5% model were calculated. Nine of these sites were accurately predicted as sites for a rate of 82%.

Data Set 2B-Campsites-Traditional Variables

Discriminant scores for 17 campsites not used in building the 5% model were calculated. Only seven of these sites were accurately predicted for a rate of 41%. Two of the misclassified sites were rockshelters. The small sample of rockshelters relative to other prehistoric campsites used in model construction and the unique nature of their locations are thought to be factors in their misclassification.

Data Sets 3A and 3B-Lithic Scatters and Campsite-Soil Variables

The 5% soils models were tested by using the 7.5 minute overlays. Although discriminant scores can be calculated for any site and nonsite test location, this would be tedious relative to using the soil overlays if, in fact, they could predict site and nonsite locations accurately.

According to the model for prehistoric campsites and lithic scatters, these sites should lie close to or within general soil units 3, 5, and 8 and far from or outside of soil unit 1. Soil unit 2 was not selected as an important discriminating variable. Prehistoric campsites and lithic scatters, as well as nonsites, sometimes occur in this general soil unit. However, it was apparent that the majority of sites located in soil unit 2 were actually distributed along the edges of the alluvium (soil unit 3) and juniper (soil unit 8). Landform X (cliffs), an important variable for campsites, could not be tested in that this landform does not correspond to a specific general soil category. It was, therefore, decided to test the hypothesis that prehistoric sites, regardless of type, will be located in general soil units 3, 5, and 8, but not in soil units 1 and 2. Nonsites, on the other hand, will be located in soil units 1 and 2, but not in soil units 3, 5 and 8.

Three tests were made using data generated independently from the data used to build the model. A total of 57 sites and 57 nonsites not used in model construction was tested by simply placing the appropriate 7.5 minute soil overlay on the USGS topographic map of interest and noting the soil field symbol or symbols of the site or transect area of interest. If more than one symbol occurred, then all symbols within the area of interest were recorded. The field symbols were then converted to their corresponding general soil unit number(s) using Table 13. In all cases, if an area of interest included even a small portion of a site associated soil, it would be classified as the site associated soil type. For example, 42GR1609, the first site recorded outside the 5% sample area, fell within the area of field symbol 413. Table 13 classifies field symbol 413 as belonging to unit 8. Therefore, 42GR1609 (the area of its location) was correctly identified as belonging to the prehistoric site group.

Test 1 included the determination of general soil types for 20 prehistoric sites recorded by Goodson & Associates, Inc. Seventeen of these sites were accurately identified for 85% predictive accuracy.

Test 2 consisted of visually inspecting the soil/site relationship for 37 prehistoric sites recorded by Nickens and Associates in 1978 and 1979. Thirty-two of the thirty-seven were accurately predicted for an accuracy rate of 86%. One of the misclassified sites was associated with a soil that did not occur in our project area (field symbol 500).

Test 3 was conducted on 57 nonsite (negative) transects recorded during the 1978 and 1979 field seasons (Reed and Nickens 1980). Thirty-seven of the fifty-seven transects were accurately predicted (65%).

Discussion

Although the traditional models indicate important individual discriminating variables, they are complicated for use alone as a management tool. The soil variable models are more informative and easier to test and use in that they provide more accurate and specific boundaries as well as reflecting many of the same variables important in traditional models. Whereas the traditional discriminating variables are often hard to measure (distance to vantage point) and interpret (the importance of high elevation above intermittent water), the soil group boundaries are easy to measure and interpret using the soil reference materials on landform, vegetation and drainage. However, the use of the traditional discriminating variables in conjunction with the soil groups can provide specific information on microenvironmental factors, e.g., mean and standard deviation of distance to primary water.

The similarities between many of the traditional and soil group discriminating variables show the interpretive power and utility as well as the ecological significance of the general soil units. For example, vantage distance and soil unit 8, distance to desert shrub and soil units 1 and 2 and distance to primary water and soil unit 3 apparently are measures of the same phenomena. These groups correspond respectively to juniper areas on the benches, cuestas and ridges in the Book Cliffs and river cliffs, desert

shrub areas in the Mancos Shale plains and alluvial fan pediments, and greasewood in the quaternary alluvium of the primary drainages (Table 17).

In general, prehistoric sites are located along the northeast/southwest trending juniper forests just below the Book Cliffs and above the river cliffs, and along the intermittent and primary drainages. Specifically, the majority are concentrated in the southwestern portions of the primary drainages near the sand dune fields of Cottonwood Wash and rock alcove/juniper areas adjacent Westwater Creek. These relationships are easy to discern using the soil models, but are difficult to interpret using the traditional model alone, due to the numerous important variables. Table 15 indicates that the only two traditional discriminators significant to both lithic scatters and campsites are desert shrub and vertical distance above other water. Examination of Table 16, however, shows that campsites and lithic scatters share all significant soil discriminators except for landform X (sandstone cliffs). Therefore, interpretation of prehistoric site location is simpler utilizing the soils models (Data Sets 3A and 3B).

Management decision-making is also further simplified by using the soil model. The tests performed on Data Sets 3A and 3B without encoding additional data yielded site prediction rates of 85% and 86%, well above ontract requirements. These rates can be increased with the addition of "buffer zones" extending into low sensitivity soil units (1 and 2) from the high sensitivity units (3, 5 and 8). For example, many of the misclassified sites in soil unit 2 are close enough to the edge of unit 3 that they are accurately predicted as site locations with the addition of a .8 mile buffer zone.

Utilizing the soil models and soil overlays, in conjunction with the traditional models when additional information on microenvironmental factors is of interest, simplifies both resource management and additional archaeological research in the Cisco Desert. This report demonstrates the close relationship between traditional and soil models and that using the latter is a logical and simpler continuation of the predictive modeling process.

TABLE 17. General Landform, Soil, Vegetation and Location Data for Site Types and Density Zones.

SITE TYPES AND DENSITY ZONES	SOIL UNIT	LOCATION	LANDFORM	VEGETATION
Low density				
Lithic scatters and campsites	2	Mancos Shale plains	shale plains	desert shrub
Medium density				
Lithic scatters	1	intermittent drainages	quaternary pediments, shale plains	desert shrub
High density				
Lithic scatters and campsites (sand dune areas)	3	primary drainages	quaternary alluvium	greasewood
High density				
Lithic scatters and campsites (quarry areas)	5	river cliffs	rock outcrops	barren to minimal grasses and desert shrub
High density				
Lithic scatters and campsites (rockshelter areas)	8	Book Cliffs and river cliffs	structural benches and cuestas	juniper

CHAPTER VI

SUMMARY AND CONCLUSIONS

The 1983 Class II survey of portions of the Cisco Oil and Gas Field by Goodson & Associates, Inc. resulted in the location and recordation of 126 sites, a much larger number of cultural resources than originally anticipated. Due to this high site density (16.4 sites per square mile overall), the research design was modified and two new predictive models were constructed using site and nonsite data collected from a 5% random survey of 80,000 acres. Rather than building a model on the previous 10% sample data and testing its predictive accuracy on the new survey data as originally planned, the opposite was done. One hundred 40-acre (1/2 mile by 1/8 mile) sample units were used to build four 5% models and the previous survey data was used in the test. The differing environmental factors between the 1983 project area and the previous study areas, as well as the concurrent site type and site density differences dictated the development of more than a single model.

In an attempt to find common discriminating factors for all the study areas, two types of models were constructed. The first used traditional environmental variables following successful modeling attempts by Larralde and Chandler (1981) and Kvamme (1980); the second type utilized BLM soil overlay orthophotoquads. Both models resulted in classification accuracy rates of over 80%, fulfilling that particular contract requirement. However, upon testing the two models, only the soil variable model (Data Set 3A and 3B) accurately predicted the location of prehistoric sites above 80%.

A simplified method of predicting potential site locations, using the soil models, was developed and tested successfully using the BLM soil overlay maps. Rather than calculating discriminant scores for an unknown location, the acetate 7.5 minute soil maps were simply laid over the area plotted on a 7.5 minute USGS topographic map. If the area of interest occurred within a soil type designated "site", it was predicted as such and, if it fell within a soil unit classified as "nonsite", the opposite was predicted. Utilizing soils as a management tool to predict the probability of locating prehistoric sites in the project area is statistically valid and also has the benefits of offering additional information over and above types of soils present. For example, depth of the soil of interest and data on elevation, precipitation, landform, temperature, slope, drainage, vegetation and fauna are available for each soil type within the general soil units. The ecological relationships among these factors are important for understanding the complex of variables involved in aboriginal selection of site locations. Specific data such as soil depth and stratigraphy may also prove valuable for prediction and evaluation of site significance and National Register eligibility.

Intensive survey of the 100 randomly selected 40-acre sample units (totaling 6.25 square miles) resulted in the recording of 104 sites. Eighty-eight prehistoric sites recorded in this 5% sample were used during the model building stage. Forty of these were lithic scatters and forty-eight were campsites, defined by the presence/absence of hearths, fire-cracked rock and/or groundstone tools. Prehistoric campsites and lithic

scatters were analyzed separately against the sample of 51 nonsites in order to determine if different environmental variables were factors in their locations.

The two sets of site groups: prehistoric lithic scatters and prehistoric campsites, were analyzed separately in the two models (soil and traditional variables). Data Set 2 represents the traditional variable analysis and Data Set 3, the soil variable analysis.

A random unstratified sampling design was used to select all 40-acre transects. All areas within the project sample universe had an equal probability of being selected. A random systematic proportionally stratified sample, used previously in the adjacent study tracts, was considered inappropriate in that generalized BLM environmental data, i.e., vegetation boundaries, had been problematic in the previous studies. The random sample method also enabled areas of unknown distribution, e.g., sand dunes, rock shelters and quarry areas, to be sampled. This provided the representative data needed to build the soils model. The results suggest that further work on the soil unit model may enable later sampling strategies to use a proportionally stratified sample based on general soil units in the area, rather than on vegetation.

Discriminant analysis identified five of the six general soil units as indicators of prehistoric site locations. Site density figures for these soil units are shown in Table 18. Extremely high prehistoric site density figures for soil units 5, 8 and 3 (22.40 to 27.35 sites per square mile) were used to define the high sensitivity zone. Soil unit 1, with a prehistoric site density of 2.66, is defined as the medium sensitivity zone and soil unit 2 (.96 sites per square mile) is the low sensitivity zone. Figure 31 depicts the location of these zones in the 1983 project area.

Soil unit 3, of the high sensitivity zone, consists of quaternary alluvium along Cottonwood Wash, Westwater Creek, Sulphur Creek, Cisco Wash and Sagers Wash. Site density in this soil unit, which comprises 13.4% of the study tract, is the highest in the project area at 27.35 sites per square mile. Soil unit 8, covering 19.6% of the project area, and located in the juniper areas along the Book Cliffs and river cliffs, is also in the high sensitivity zone with 24.93 sites per square mile. Soil unit 5, also in the high sensitivity zone, covers 2.7% of the study area, and consists of a rock outcrop area at the base of the river cliffs southwest of Cottonwood Wash. It supports a site density of 22.40 sites per square mile. The total area covered by the three soil units making up the high sensitivity zone is 43.6% of the study tract.

The medium sensitivity zone, represented by soil unit 1 (quaternary pediments of the intermittent drainages), has a site density of 2.66 sites per square mile. This compares favorably with Reed and Nickens (1980) medium sensitivity zone site density figure of 2.55 sites per square mile for their drainage stratum. This stratum includes many intermittent drainages of this soil unit. In the 1983 project area, these zones of medium sensitivity occur in an unnamed area below the Book Cliffs southwest of Sulphur Creek and in Nash Wash. These areas comprise 8.1% of the project area.

TABLE 18. Site Density in the Project Area.

Soil Unit and Total Acres	Number of Sites*			Sites/Square Mile			
	Pre.	Hist.	Total	Pre.	Hist.	Total	
2 (38,652)	2	2	4	.96	.95	1.90	Low Density
1 (6,494)	2	0	2	2.66	0	2.66	Medium Density
5 (2,183)	7	0	7	22.40	0	22.40	
8 (15,689)	34	5	3	24.93	3.66	28.59	High Density
3 (10,718)	45	7	52	27.35	4.25	31.60	
9** (6,264)	0	0	0	0	0	0	
Over All (80,000)	90	14	104	14.40	2.24	16.64	

* includes only sites recorded in the 5% sample

** only two transects were surveyed in this soil unit

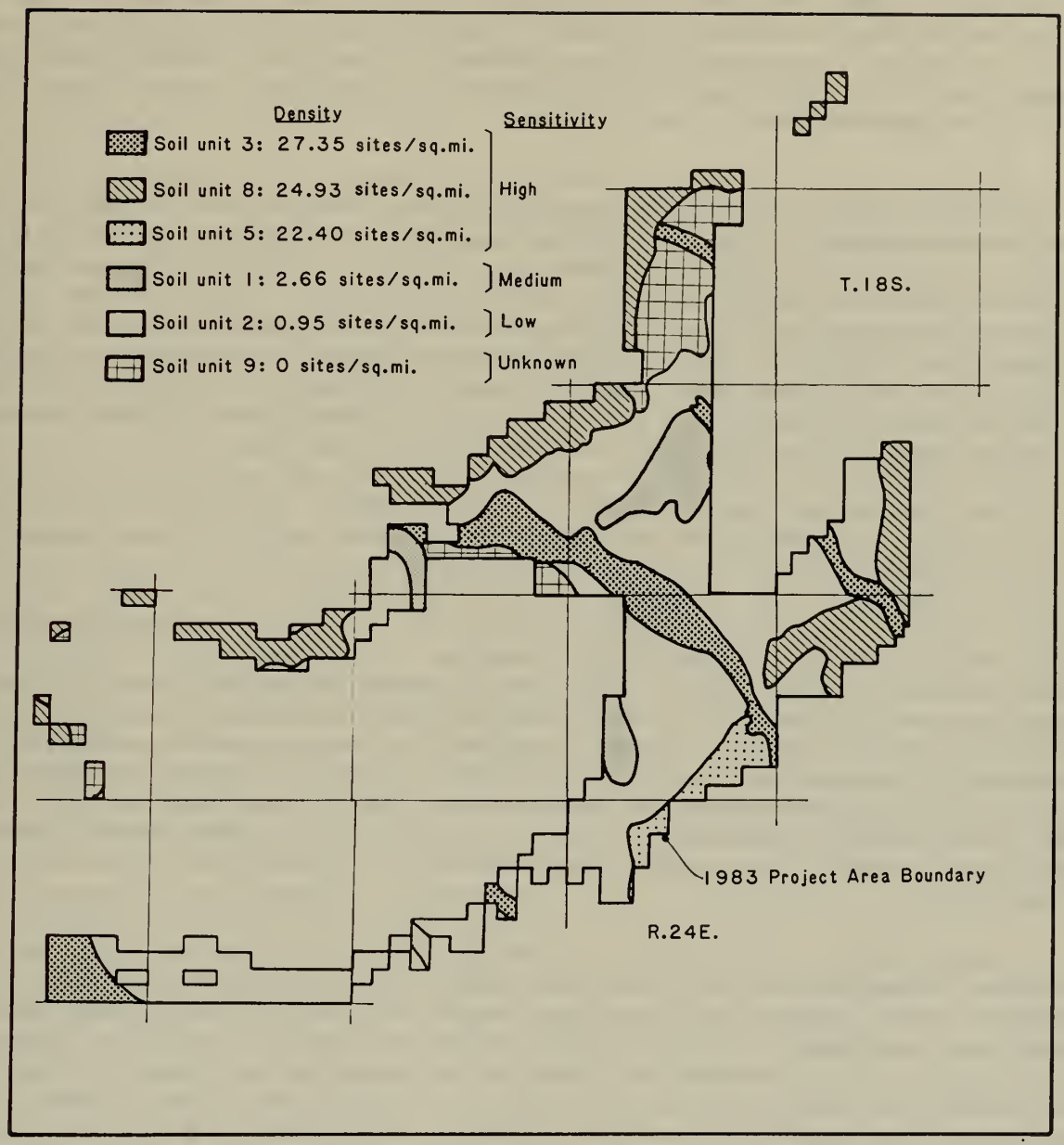


Figure 31. Prehistoric Site Densities and Sensitivity Zones within the Cisco III Project Area.

The low sensitivity zone, soil unit 2, corresponds to Reed and Nickens (1980) desert shrub stratum of the Mancos Shale plains. Site density is .96 sites per square mile and includes 48.3% of the survey area. In their previous surveys, corrected for erroneously classified stratum, Reed and Nickens recorded .38 sites per square mile in this soil unit. Again, the figures compare favorably.

Although no sites were recorded in soil unit 9, this general soil type is the same as that at the mouth of Nash Wash on the west end of the project area, where numerous prehistoric sites have been recorded and where Reed and Nickens classified the sensitivity as high (9.6 sites per square mile). This soil unit included only 7.8% of the 1983 study area, and the small sample (two transects) may not be representative of this unit. Soil unit 9 in the Cisco project area comprises mostly grass and sagebrush areas, whereas this unit near the mouth of Nash Wash includes numerous juniper ridges. Further work in soil unit 9 is needed to determine its site density in the central and northeastern portions of the Cisco area.

Data collected during this Cisco III project indicate that the Cisco Desert has very high site density areas as well as the very low site density areas as previously hypothesized (Reed and Nickens 1980). These high site density areas are not uniformly scattered throughout the area, but are concentrated in localities having a variety of desirable resources including food, water, shelter and raw lithic material. Campsites are as numerous as lithic scatters with fairly even distribution throughout the high site density areas (Figure 15). The more diverse environmental zones located in the Cisco III project area as compared to the previous survey areas undoubtedly account for the great differences in site density figures and the much higher percentage of campsites. These zones include permanent water and associated resources, e.g., Cottonwood Wash, sand dunes, outcrops of lithic source materials and geologic formations conducive to rockshelters.

Examination of the diagnostic artifact distributions suggests several patterns. The majority of sites yielding Fremont diagnostics (seven) were located on the juniper terrace just below the Book Cliffs. Two Fremont sites were recorded in the Cottonwood Wash corridor, but none were recorded in the Westwater Archaeological District or along the southeastern edge of the project area (Figure 24). It is quite possible that these sites, both campsites (four) and lithic scatters (five), were associated with the nearby Turner-Look Formative village site. If this is true, then it appears to substantiate the theory that hunting and gathering were important segments of Fremont subsistence strategy. Collected foodstuffs may have included cattails, rushes and Indian ricegrass (on dune areas) along Cottonwood Wash. The hunting of mule deer during their annual migration through the juniper areas would, of course, also support this interpretation (Grady 1980:82).

The Archaic and Late Prehistoric diagnostic sites occur principally in the Cottonwood and Westwater Archaeological Districts, with only a single Late Prehistoric campsite recorded on the first terrace below the Book Cliffs (Figure 24). Two hypotheses are suggested by this distribution. The nomadic populations may have been moving north to south between the higher elevations of the Book Cliffs and the lower elevations just above and along the Colorado River. Cottonwood Wash and Westwater Creek drainages could

have been utilized as migration corridors concurrent with seasonally available resources. Another possibility is that the seasonal migration routes paralleled the Colorado River in a northeast/southwest fashion. A wider variety of resources and shelter would have been available to the aboriginal population if they remained near the juniper/sage/desert shrub ecotone above the Colorado River, than if movement was actually within the canyon.

Either or both patterns of seasonal migration might explain the relative paucity of Archaic and Late Prehistoric sites along the terraces below the Book Cliffs. Summer occupation might have been at higher elevations northwest of the project area and intermittent stops would not be needed on these terraces between the Book Cliffs and Cottonwood or Westwater drainage corridors. The rock formations near the Colorado River provide ample shelter for small bands of people as evidenced by the rockshelters recorded during this project. If sufficient resources could be collected along the river cliffs and lower reaches of the major drainages, access to higher elevations may not have been necessary. Additional data collection, especially in the Book Cliffs and on the first terraces below and along the Colorado River, will be necessary to test these and other hypotheses.

RECOMMENDATIONS

If the BLM land managers choose to use this study as a tool for determining probabilities of prehistoric site occurrence in the Cisco area, two models have been presented for their consideration. However, based on the results of these studies, only one method is recommended. While the traditional variables can be measured and encoded for any 40-acre study tract, resulting in a discriminant score for that area, the tests of this model have resulted in a less than 80% predictive rate. The method is also time-consuming and somewhat cumbersome to use. Therefore, a much simpler and more accurate method is recommended.

The correlation between sites and soils has been demonstrated and tested, and a site sensitivity map presented (Figure 31). For specific areas of concern, it is recommended that the soil overlays be used in conjunction with the BLM's soils data and the results of this study. Any area that is included in the high sensitivity zones of general soils units 3, 5 and 8 should be surveyed. Areas in soil unit 9 should also be surveyed prior to ground-disturbing activities, as this was included in Reed and Nickens (1980) high density zone and the results of sampling during this project are inconclusive due to the small sample size.

Soil unit number 1 is classified as a medium site sensitivity zone, although site density is substantially lower than units 3, 5, and 8. It corresponds closely to Reed and Nickens (1980) medium sensitivity zone, encompassing the intermittent drainages of the project area. Management recommendations for this zone remain consistent with those in the previous project areas, and land within the zone should be surveyed prior to surface modifications

Soil unit 2, the low sensitivity zone, generally corresponds with Reed and Nickens' low site density zone, i.e., the desert shrub stratum. If

survey requirements in this zone are waived by the BLM, isolated eligible sites may be endangered. It is recommended that all areas within a .8 mile buffer zone of soil units 3, 5, 8 and 9 continue to be surveyed in order to protect these sites and further test the model's accuracy. This .8 mile buffer zone includes sites misclassified by the soils model (Figure 32).

Initially, it is recommended that all locations of potential land-disturbing activities be surveyed. This would be an excellent check of the model and theories, and help to refine the BLM's land managing policies. Additionally, soil models have not been as widely used as vegetation models and the additional data would be very useful.

Additional care should be taken when activities are planned within the two proposed archaeological districts due to the high potential for encountering cultural resources. This is especially applicable in the proposed Cottonwood District because of the type of soil (alluvium). Monitoring certain activities, such as road construction, is recommended, as there is a high likelihood of buried sites.

In anticipation of future modeling projects, several recommendations are presented. Any area targeted for such investigation should be examined closely prior to model development. Environmental factors vary greatly from region to region, and what may be appropriate in one model, e.g., shelter quality, may not be significant in another. The site type variability within a project area should also be considered and the possibility of developing more than a single model investigated. Known site types should be analyzed separately, as this too may lead model building in a specific direction. If possible, a preliminary model should be developed from existing site and nonsite data prior to any fieldwork. Undoubtedly, this model will be refined, however, it may give a good indication of problems that might be encountered, or focus attention on specific approaches or significant environmental variables. This study indicated that soil groups are good discriminators in the Cisco area, and it is recommended that this variable be tested for significance in future models in other areas.

Soil maps are available for many areas, especially when large tracts of Federal land are involved. Soil maps, however, are not necessarily a panacea for predictive models. As demonstrated, a statistically valid model must be developed and tested with independent data prior to reliance solely on map information.

The model should be tested during the fieldwork if it is developed with previously collected data. If survey is necessary prior to model construction, additional data should be collected to test and refine the model. Investigators need to be flexible and tailor their models to the environmental conditions and cultural resource types found in their specific project areas. Additionally, it is recommended that models be constructed using a conservative confidence level. While broader confidence limits may yield higher classification percentages, the resulting functions may not necessarily produce a better prediction rate. The idea is to have a working, usable model, not inflated classification percentages.

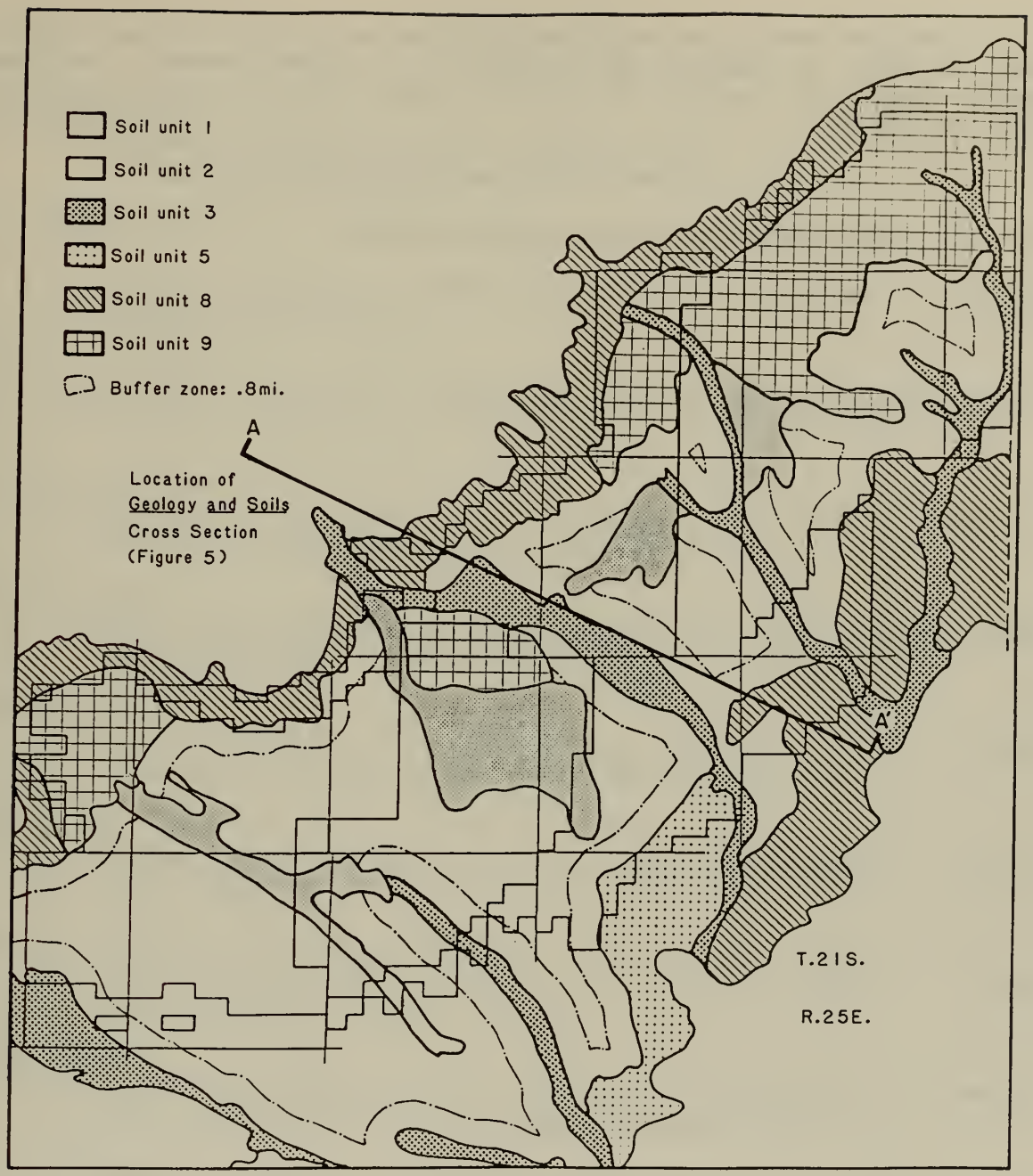


Figure 32. General Soil Units within the Cisco Area with .8 mile Buffer Zone.

Predictive models can be a benefit to archaeologists and land managers alike, if they are constructed and used in a proper fashion. The final reminders are to be flexible, be project or area specific, and to keep it as simple as possible.

REFERENCES CITED

Aikens, C. Melvin
1966 "Fremont-Promontory-Plains Relationships in Northern Utah." University of Utah Anthropological Papers, No. 82.

1970 "Hogup Cave." University of Utah Anthropological Papers, No. 93.

1972 "Fremont Culture: Restatement of Some Problems." American Antiquity 37(1):61-66.

Ambler, J. Richard
1966 "Caldwell Village." University of Utah Anthropological Papers, No. 84.

Athearn, Frederic J.
1981 "An Isolated Empire - A History of Northwestern Colorado." Colorado BLM Cultural Resource Series, No. 2.

Athearn, Robert G.
1962 Rebel of the Rockies - A History of the Denver and Rio Grande Western Railroad. Yale University Press.

Babcock, Thomas
1981 Utah Antiquities Site Inventory, 42GR1269. United States Department of Interior, Bureau of Land Management.

Barnes, F.A.
1978 Canyon Country Geology for the Layman and Rockhound. Wasatch Publishers, Inc.

Benedict, James B. and Byron L. Olson
1973 "Origin of the McKean Complex: Evidence From Timberline." Plains Anthropologist 18(62):323-327.

Berge, Dale L.
1980 "Simpson Springs Station: Historical Archaeology in Western Utah." Utah BLM Cultural Resource Series, No. 6.

Berry, Michael S.
1975 "An Archaeological Survey of the Northeast Portion of Arches National Park." Antiquities Section Selected Papers, No. 3. Salt Lake City, Utah.

Birkeland, Peter W.
1974 Pedology, Weathering and Geomorphological Research. Oxford University Press, Inc., New York.

Blumenstein, Lynn
1965 Redigging the West for Old Time Bottles. Old Time Bottle Publishing Company, Salem, Oregon.

Breternitz, David A.
1970 "Archaeological Excavations in Dinosaur National Monument, Colorado - Utah, 1964-1965." University of Colorado Studies, Series in Anthropology, No. 17. University of Colorado Press.

Breternitz, David A., Arthur H. Rohn, and Elizabeth A. Morris
1974 "Prehistoric Ceramics of the Mesa Verde Region." Museum of Northern Arizona, Ceramic Series, No. 5.

Burgess, Robert J., Kenneth L. Kvamme, Paul R. Nickens, Alan D. Reed and Gordon C. Tucker, Jr.
1980 "Class II Cultural Resource Inventory of the Glenwood Springs Resource Area, Grand Junction District, Colorado." Bureau of Land Management Contract Number YA-512-CT9-222. Nickens and Associates, Montrose, Colorado.

Busch, Jane
1981 "An Introduction to the Tin Can." Historical Archaeology, Vol. 15.

Carlson, Roy L.
1965 "Eighteenth Century Navajo Fortresses of the Gobernador District." University of Colorado Studies, Series in Anthropology, No. 10. Boulder, Colorado.

1973 "Archaeological Salvage and Survey in Nebraska: Highway Archaeological and Historical Salvage Investigations in Nebraska, 1965 to 1968." Nebraska State Historical Society Publications in Anthropology, No. 5.

Cashion, William B.
1973 Geologic and Structure Map of the Grand Junction Quadrangle, Colorado and Utah. Miscellaneous Geologic Investigations Map I-736, U.S. Geological Survey.

Chandler, Susan M. and Paul R. Nickens
1979 "Archaeological Investigations at Two Power Plant Sites and Water Pipeline Corridors for the Moon Lake Project, Rio Blanco County, Colorado, and Uintah County, Utah." Ms. on file at BLM, Vernal District, Utah.

Clifton, Robert T.
1970 Barbs, Prongs, Points, Prickers and Stickers - A Complete and Illustrated Catalogue of Antique Barbed Wire. University of Oklahoma Press, Norman, Oklahoma.

Conn, Richard
1984 Personal communication concerning historic trade beads.

Crabtree, Donald E.
1972 "An Introduction to Flintworking." Occasional Papers of the Idaho State University Museum, No. 28. Pocatello, Idaho.

Creasman, Steven D.
1981 "Archaeological Investigations in the Canyon Pintado Historic District, Rio Blanco County, Colorado - Phase I: Inventory and Test Excavations." Reports of the Laboratory of Public Archaeology, No. 34. Fort Collins, Colorado.

Ellwood, Priscilla
1984 Personal communication concerning ceramic identification.

Fawcett, Bill
1979 "Dating Late 19th and Early 20th Century Historic Sites." Unpublished manuscript.

Fike, Richard E.
1983 Personal communication concerning site 42GR1677.

1984 Personal communication concerning dates for purple glass.

Firebaugh, Gail S.
1983 "An Archaeologist's Guide to the Historical Evolution of Glass Bottle Technology." Southwestern Lore 49(2):9-29.

Francis, Peter Jr.
n.d. "The Story of Venetian Beads." The World of Beads Monograph Series, Vol. 1.

Frison, George C.
1978 Prehistoric Hunters of the High Plains. Academic Press, New York.

Grady, James
1980 "Environmental Factors in Archaeological Site Locations, Piceance Basin, Colorado." Colorado BLM Cultural Resource Series, No. 9.

Gunnerson, James H.
1960 "The Fremont Culture: Internal Dimensions and External Relationships." American Antiquity 25:373-380.

1969 "The Fremont Culture." Papers of the Peabody Museum, Vol. 59(2).

Hauck, F.R.
1977 "Cultural Resource Evaluation in Central Utah." Utah BLM Cultural Resource Series, No. 3.

Heizer, Robert F. and Thomas R. Hester
1978 Great Basin Projectile Points: Forms and Chronology. Ballena Press, Socorro, New Mexico.

Holmer, Richard N.
1978 A Mathematical Typology for Archaic Projectile Points of the Eastern Great Basin. Unpublished Ph.D. dissertation, on file at Department of Anthropology, University of Utah.

1979 "Split Mountain Cultural Study Tract," Contract No. UT-080-CT9-003. Unpublished manuscript submitted to the BLM, Vernal District, Utah.

Hunt, Alice P. and Dallas Tanner
1960 "Early Man Sites Near Moab, Utah." American Antiquity 26(1):110-117.

Hunt, Charles B.
1972 Geology of Soils, Their Evolution, Classification, and Uses. W.H. Freeman and Company, San Francisco.

Husted, Wilfred M. and Oscar L. Mallory
1967 "The Fremont Culture: Its Derivation and Ultimate Fate." Plains Anthropologist 12(36):222-232.

Hutchings, Theron B. and Don. R. Murphy
1981 "Soils." In Atlas of Utah, edited by Wayne L. Wahlquist, p. 28-29, Brigham Young University Press.

Jennings, Calvin
1984 Personal communication concerning ceramic identification.

Jennings, Jesse D.
1974 Prehistory of North America. Second edition, McGraw Hill Inc., New York.

1978 "Prehistory of Utah and the Eastern Great Basin." University of Utah Anthropological Papers, No. 98.

Jennings, Jesse D., Alan R. Schroedl and Richard N. Holmer
1980 "Sudden Shelter." University of Utah Anthropological Papers, No. 103.

Jones, Kevin T. and Kathryn L. MacKay
1980 "Cultural Resources Existing Data Inventory Vernal District Utah." Reports of Investigations 80-18. Prepared under contract between BLM and University of Utah Archaeological Center.

Kidd, Kenneth E. and Martha A. Kidd
1970 "A Classification System for Glass Beads for the Use of Field Archaeologists." Canadian Historic Sites: Occasional Papers in Archaeology and History, No. 1. National Historic Sites Service, Ottowa.

Kvamme, Kenneth L.
1979 Utah Antiquities Site Inventory, 42GR904. United States Department of Interior, Bureau of Land Management.

1980 "Predictive Model of Site Location in the Glenwood Springs Resource Area." Class II Cultural Resource Inventory of the Glenwood Springs Resource Area, Grand Junction District, Colorado, pp.88-136. Prepared by Nickens and Associates for BLM, Grand Junction, Colorado.

1982 "Methods for Analyzing and Understanding Hunter-Gatherer Site Location as a Function of Environmental Variation." Paper presented at The Society for American Archaeology meetings, Minneapolis.

Larralde, Signa L. and Susan M. Chandler
1981 "Archaeological Inventory in the Seep Ridge Study Tract, Uintah County, Northeastern Utah." Utah BLM Cultural Resource Series, No. 11.

Lee, Susan K. and Richard Clements
1981 "A Cultural Resource Survey of a Proposed Humate Mine in Grand County, Utah." University of Utah Reports of Investigations, No. 81-7.

Lindsay, LaMar W.
1976 "Grand County: An Archaeological Summary." Antiquities Section, Division of State History, Salt Lake City, Utah.

Madsen, David B.
1979 "The Fremont and the Sevier: Defining Prehistoric Agriculturalists North of the Anasazi." American Antiquity 44(4):711-722.

Madsen, David B. and Michael S. Berry
1975 "A Reassessment of Northeastern Great Basin Prehistory." American Antiquity 40(4):391-405.

Madsen, David B. and LaMar W. Lindsay
1977 "Backhoe Village." Antiquities Section Selected Papers, No. 12. Salt Lake City, Utah.

Marwitt, John P.
1970 "Median Village and Fremont Culture Regional Variation." University of Utah Anthropological Papers, No. 95. Salt Lake City, Utah.

McCallum, Henry D. and Frances T.
1965 The Wire that Fenced the West. University of Oklahoma Press, Norman, Oklahoma.

Mehls, Steven F.
1982 "The Valley of Opportunity. A History of West-Central Colorado." Colorado BLM Cultural Resource Series, No. 12.

Munsey, Cecil
1970 The Illustrated Guide to Collecting Bottles. Hawthorn Books, Inc., New York.

Murphy, Don R.
1981 "Physiographic Provinces." In Atlas of Utah, edited by Wayne L. Wahlquist, p. 17. Brigham Young University Press.

Nickens, Paul R.
1979 "Prehistoric Cultural Resources of Rio Grande National Forest." Centuries Research, Inc., Montrose, Colorado.

Nie, Norman H., C. Hadlai Hull, Jean G. Jenkins, Karin Steinbrenner and Dale H. Bent
1975 Statistical Package for the Social Sciences. McGraw-Hill, New York.

Pierson, Lloyd M.
1981 "Cultural Resource Summary of the East-Central Portion of Moab District, 1980." Utah BLM Cultural Resource Series, No. 10.

Powers, Margaret A.
1983 "An Archaeological Survey of Three Seismic Lines North of Moab, San Juan and Grand Counties, Utah." Contributions to Anthropology Series, No. 790. San Juan County Archaeological Research Center and Library. Division of Conservation Archaeology.

Reed, Alan D.
1984 West-Central Colorado Prehistoric Context. Colorado Historical Society.

Reed, Alan D. and Ronald E. Kainer
1978 "The Tamarron Site, 5LP326." Southwestern Lore 44:1-47.

Reed, Alan D. and Paul R. Nickens
1980 "The Cisco Cultural Resource Study. A Sample-Oriented Inventory, East-Central Utah." In Sample Inventories of Oil and Gas Fields in Eastern Utah 1978-1979. Assembled by Paul R. Nickens. Utah BLM Cultural Resources Series, No. 5.

Reed, Alan D. and Douglas D. Scott
1982 "Uncompahgre and Gunnison Resource Areas." In Archaeological Resources of Southwestern Colorado. Colorado BLM Cultural Resource Series, No. 13.

Richardson, E. Arlo, Gaylen L. Ashcroft, and John K. Westbrook
1981a "Temperature." In Atlas of Utah, edited by Wayne L. Wahlquist, pp. 58-60. Brigham Young University Press.

1981b "Freeze-Free Season." In Atlas of Utah, edited by Wayne L. Wahlquist, pp. 62-63. Brigham Young University Press.

1981c "Precipitation." In Atlas of Utah, edited by Wayne L. Wahlquist, pp. 66-69. Brigham Young University Press.

1981d "Snowfall." In Atlas of Utah, edited by Wayne L. Wahlquist, p. 70. Brigham Young University Press.

Schroedl, Alan R.
1976 The Archaic of the Northern Colorado Plateau. Unpublished Ph.D. dissertation on file at Department of Anthropology, University of Utah.

Schroedl, Alan R. and Patrick F. Hogan
1975 "Innocents Ridge and the San Rafael Fremont." Antiquities Section Selected Papers, No. 42. Salt Lake City, Utah.

Soil Conservation Service
1982 "Soil Survey of Grand County, Central Part, Utah."

Thorn, C. Jordan
1947 Handbook of Old Pottery and Porcelain Marks. Tudor Publishing Company, New York.

Toll, Henry W. III
1978 "Quartzite Lithic Material in Archaeology: Qualities and Quandries with Special Reference to Use-Wear." Plains Anthropologist 23(79):47-68.

Toulouse, Julian Harrison
1971 Bottle Makers and Their Marks. Thomas Nelson, Inc., New York.

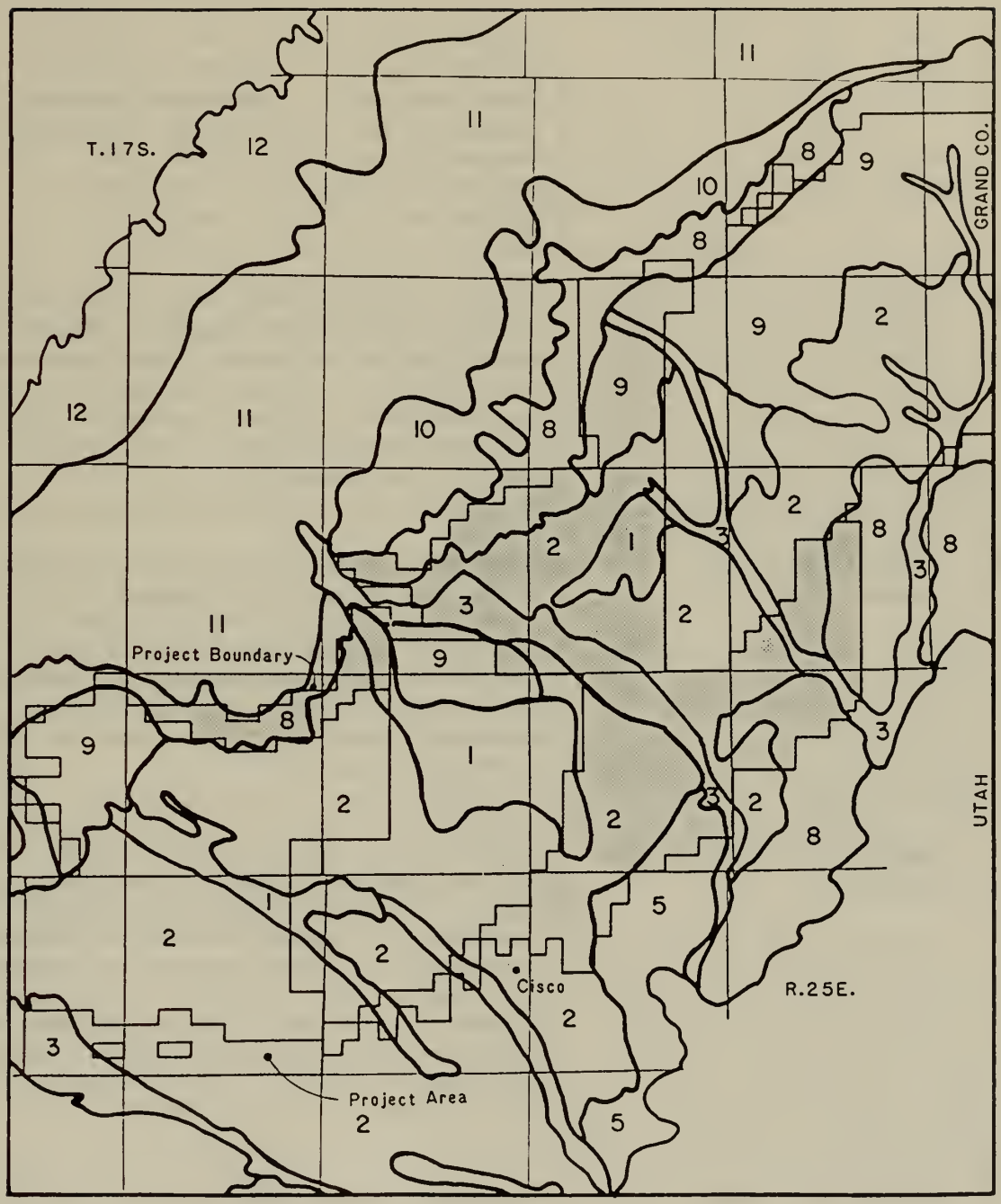
Upper Colorado Region State-Federal Inter-Agency Group
1971 "Characteristics of Lands: Soils." Appendix 6 In Upper Colorado Region, Comprehensive Framework Study.

Wormington, H. Marie
1955 "A Reappraisal of the Fremont Culture." Proceedings, No. 1. Denver Museum of Natural History. Denver, Colorado.

APPENDIX 1

A MAP OF GENERAL SOIL UNITS

B DESCRIPTION OF GENERAL SOIL UNITS



Appendix 1A

MAP OF GENERAL SOILS UNITS

Appendix 1B

General Soil Units, Grand County, Utah, Central Part

General Unit Number/ Major Soil Components	General Description
1. Mesa - Mack - Chipeta	Shallow to very deep, well drained, gently sloping to moderately steep (2 to 50%) loamy soils located on alluvial fan pediments and shale plains. Elevation ranges from 4,100 to 5,200 feet. Major vegetation types include shadscale, galleta and Indian ricegrass.
2. Chipeta - Killpack - Blueflat	Shallow to moderately deep, well drained, gently sloping to steep (1 to 50%) clayey soils located on shale plains, pediments and cuestas. Elevation ranges from 4,000 to 5,000 feet. Major vegetation types are mat saltbush, Nuttall saltbush, galleta and winterfat.
3. Toddler - Ravola - Glenton families	Very deep, well drained, gently sloping (0 to 3%) loamy soils located on fans, flood plains, and along drainages. Elevation ranges from 4,000 to 5,000 feet. Mat saltbush, shadscale, seepweed, alkali sacaton, and galleta with scattered black greasewood are the major vegetation types.
4. Badland - Rock Outcrop Moenkopie	Badland, Rock outcrop, and shallow, well drained, gently sloping to moderately steep (3 to 20%) loamy soils formed in residuum from sandstone and interbedded shale on structural benches, ridgetops, and sideslopes. Elevation ranges from 4,000 to 4,900 feet. Major vegetation types include shadscale, Indian ricegrass and some blackbrush. Approximately 50% of the area is void of vegetation.
5. Moenkopie - Nakai - Rock outcrop	Shallow to deep, well drained, gently sloping to moderately steep (1 to 20%) loamy soils, formed in residuum, alluvium, and some eolian materials from sandstone, on cuestas, structural benches, and valley sideslopes; and rock outcrop. Elevation ranges from 4,000 to 5,000 feet. Major vegetation types are shadscale, galleta, Indian ricegrass, four-wing saltbush, and some blackbrush.

Appendix 1B

General Soil Units, Grand County, Utah, Central Part (Continued)

General Unit Number/ Major Soil Components	General Description
6. Thedalund family, stony-Walknolls family - Pennell	Shallow to deep, well drained, sloping to very steep (3 to 70%) stony soils on cuestas, benches and in canyons. Elevation ranges from 4,200 to 6,100 feet. Major vegetation types include Salina wildrye, shadscale, Nuttall saltbush, and galleta.
7. Rizno - Begay - Rock outcrop	Shallow to very deep, well drained, gently sloping to moderately steep (2 to 40%) loamy soils on structural benches, cuestas, and mesas. Elevation ranges from 4,700 to 6,400 feet. Major vegetation types are blackbrush, Mormon-tea, juniper, galleta, Indian ricegrass, needle-and-thread grass, four-wing saltbush, and some big sagebrush.
8. Shalako, dry-Thedalund family, stone-Hanksville family	Shallow to deep, well drained, gently sloping to very steep (3 to 70%) loamy and stony soils on benches, cuestas, alluvial fans, and canyon escarpments. Elevation ranges from 4,400 to 6,500 feet. Major vegetation types include juniper, shadscale, big sagebrush, salina wildrye and Nuttall saltbush.
9. Barz - Strych - Sandoval	Shallow to very deep, well drained, gently sloping to moderately steep (1 to 15%) loamy soils on alluvial fan pediments, alluvial fans, and shale pediments. Elevation ranges from 5,000 to 6,000 feet. Major vegetation types are big sagebrush, galleta, spiny hop-sage, juniper, pinyon and salina wildrye.
10. Thedalund family, moist-Thedalund family stony - Dast family	Moderately deep to deep, well drained, steep to very steep (50 to 70%) loamy and stony soils on canyon escarpments and mountainsides. Elevation ranges from 4,400 to 7,700 feet. Major vegetation types include Utah juniper, pinyon and salina wildrye.

Appendix 1B

General Soil Units, Grand County, Utah, Central Part (Continued)

General Unit Number/ Major Soil Components	General Description
11. Dast family - Reva family - Shalako	Shallow to very deep, well drained, sloping to very steep (3 to 80%) loamy and stony soils on benches and mountainsides. Elevation ranges from 5,700 to 8,600 feet. Major vegetation types are pinyon, juniper, Douglas fir, mountain-mahogany, and serviceberry.
12. Sula family - Razorba family, Reva family	Shallow to very deep, well drained, steep and very steep (50 to 80%) loamy and stony soils on mountainsides. Elevation ranges from 7,000 to 9,100 feet. Major vegetation types include Douglas fir, pinyon, snowberry, Gambel oak, and mountain big sagebrush.

APPENDIX 2

PREHISTORIC SITE SUMMARY

APPENDIX 2. The following section tabulates cultural features recorded at each of the 111 aboriginal sites. Symbols used to identify site types, and the frequency of each site type is as follows:

SYMBOL	SITE TYPE	TOTAL
LS	Lithic Scatter	46
LC	Lithic/ceramic scatter	3
CH	Campsite with hearth(s)	42
CG	Campsite with groundstone	5
GH	Campsite with hearth(s) and groundstone	4
Q	Quarry	2
Q/CH	Quarry and Campsite with hearth(s)	3
RS	Rockshelter	6
TOTAL		111

APPENDIX 2. PREHISTORIC SITE SUMMARY

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1598	LS	4565	725	-	-	-	-	-	-	No
42GR1603	LS	5320	10	-	-	-	-	-	-	No
42GR1604	LS	5280	45		-	-	-	1	-	No
42GR1605	LC	5280	544	1 biface	-	+	-	-	-	Yes
42GR1606	GH	4560	12,100	2 bifaces	3 metate fragments, 2 mano fragments	-	+	1	Aeolian	Yes*
42GR1607	CH	4560	5,000	3 points 2 scrapers	-	-	+	1	Aeolian	Yes*
42GR1608	CG	4560	3,600	1 biface	1 mano, 1 metate frag. 1 unidenti-fied frag	-	-	-	Aeolian	Yes*
42GR1609	LC	5240	1,050	-	-	+	-	-	-	Yes
42GR1610	CH	5050	50	-	-	-	-	1	Aeolian	No
42GR1611	LS	4520	26,325	-	-	-	-	-	-	Yes*
42GR1612	LS	4500	2,100	2 bifaces 1 point	-	-	-	-	-	Yes*

* Denotes part of Cottonwood Archaeological District
** Denotes part of Westwater Archaeological District

APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1613	LC	4510	1,250	2 bifaces	-	+	-	-	-	Yes*
42GR1614	LS	4510	80	-	-	-	-	-	-	Yes*
42GR1615	LS	4500	89,304	1 biface 1 point	-	-	-	-	-	Yes**
42GR1616	LS	4560	12,800	1 point 2 bifaces	-	-	-	-	-	Yes**
42GR1617	LS	4620	1,050	1 point	-	-	-	-	-	Yes**
42GR1618	CH	4720	990	2 biface fragments	-	-	-	-	Alluvial	Yes**
42GR1619	LS	4720	3,600	-	-	-	-	-	-	Yes**
42GR1620	CH	4640	750	-	-	-	+	1	-	Yes**
42GR1622	LS	4600	2,800	-	-	-	-	1	-	Yes**
42GR1623	RS	4480	50	-	-	-	-	-	-	Yes**
42GR1624	LS	4600	80	-	-	-	-	-	-	Yes**
42GR1625	LS	4540	6,000	2 points 4 bifaces	-	-	-	-	-	Yes**
42GR1626	LS	4520	6,050	-	-	-	-	-	-	Yes**

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1627	CG	4720	3,600	1 biface/ chopper	+	-	+	-	-	Yes
42GR1628	CH	4490	14,000	-	-	-	+	-	-	Yes
42GR1629	GH	4490	5,510	-	1 metate fragment 2 manos	-	+	2	-	Yes
42GR1630	LS	4500	2,490	1 biface	-	-	-	1	-	Yes*
42GR1631	CG	4520	27,000	2 bifaces 1 knife	1 unidenti-fied frag.	-	-	-	-	Yes*
42GR1632	LS	4510	9,000	-	-	-	-	-	-	Yes*
42GR1633	LS	4490	600	-	-	-	-	-	Aeolian	Yes*
42GR1634	LS	4520	560	1 biface	-	-	-	-	Aeolian	Yes*
42GR1635	CH	4520	7,200	1 biface 2 points	-	-	+	-	Aeolian	Yes*
42GR1636	LS	4520	3,600	1 biface	-	-	-	-	Aeolian	Yes*
42GR1637	LS	4520	144	-	-	-	-	-	Alluvial	Yes*
42GR1638	LS	4520	2,600	-	-	-	-	1	-	Yes*
42GR1639	LS	4640	100	-	-	-	+	-	-	Yes

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1642	LS	4515	9,600	1 point 1 biface 1 chopper	-	-	-	1	Aeolian	Yes*
42GR1643	LS	4510	2,496	-	-	-	-	-	Aeolian	Yes*
42GR1644	LS	4520	10,200	1 biface fragment	-	-	-	-	Aeolian	Yes*
42GR1645	CH	4510	4,800	1 point	-	-	+	-	Aeolian	Yes*
42GR1646	LS	4530	280	-	-	-	-	-	-	No
42GR1653	CH	4740	726	-	-	-	+	2	-	Yes
42GR1654	CH	4580	40	-	-	-	+	-	-	No
42GR1655	CH	4780	2,800	-	1 mano	-	+C/14 Sample	-	-	Yes*
42GR1656	CH	4780	125	-	-	-	+	-	-	Yes*
42GR1657	CH	4820	675	-	1 metate fragment	-	+	-	-	Yes*

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1658	CH	5060	5,100	-	-	-	+C/14 Sample	-	-	Yes*
42GR1659	LS	5480	1,645	1 point	-	-	-	-	-	No
42GR1660	LS	4540	4,675	1 scraper	-	-	-	-	-	No
42GR1661	RS	4600	72	-	-	-	-	-	-	Yes**
42GR1662	LS	4580	4,125	-	-	-	-	1	-	Yes**
42GR1663	RS	4600	7	-	-	-	-	-	-	Yes**
42GR1664	LS	4620	7,140	2 bifaces 1 hammer-stone	-	-	-	10	-	Yes**
42GR1665	CH	5580	14,400	2 points	-	+	+	-	-	Yes
42GR1666	CH	4360	640	1 biface	-	-	+	1	-	Yes
42GR1667	Q/CH	4320	105,000	3 bifaces	-	-	+	20	-	Yes
42GR1668	LS	4320	7,200	2 bifaces	-	-	-	2	-	Yes
42GR1669	LS	4420	2,800	1 biface	-	-	-	2	-	Yes

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1670	LS	4400	1,332	2 scrapers	-	-	-	2	-	Yes
42GR1671	CH	4600	1,750	1 point	-	-	+	1	-	Yes**
42GR1673	CH	4830	2,975	1 scraper	-	+	+	-	-	Yes*
42GR1675	GH	4480	3,600	-	1 mano fragment	-	+	1	-	No
42GR1676	CH	5220	87,500	3 points 4 bifaces	1 metate fragment	-	+	-	-	Yes
42GR1680	CH	4600	30,250	2 points 1 uniface 2 bifaces 1 hammer-stone	-	-	+C/14 Sample	2	-	Yes
42GR1681	LS	5320	8,800	2 points 2 bifaces 1 knife	-	-	-	-	-	Yes
42GR1682	RS	4700	720	1 knife 2 bifaces 1 hammer-stone	-	-	+	-	-	Yes
42GR1683	CH	4430	6,000	3 bifaces	-	-	+	-	-	No

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1684	LS	4475	3,500	-	-	-	-	-	-	No
42GR1685	CH	4440	900	-	-	-	+	-	-	No
42GR1686	GH	5080	30,000	-	1 mano	+	+	-	-	Yes
42GR1687	CH	4500	2,475	1 uniface	-	-	+	1	-	Yes*
42GR1688	CH	4520	3,000	2 bifaces	-	-	+	1	-	Yes*
42GR1689	CH	4520	4,000	-	-	-	+C/14 Sample	-	-	Yes*
42GR1690	CH	4520	1,250	-	-	-	+	-	-	Yes*
42GR1691	LS	4520	675	1 biface fragment	-	-	-	-	-	Yes*
42GR1692	CH	4480	8,000	2 bifaces 1 triface	-	-	+	-	-	Yes*
43GR1693	Q	4520	247,500	-	-	-	-	test cobbles	-	Yes

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1694	CH	4520	1,350	2 bifaces	-	-	+	-	-	Yes*
42GR1695	CH	4520	400	1 biface core/ chopper	-	-	+	1	-	Yes*
42GR1696	CH	4540	2,250	3 bifaces	-	-	+	1	-	Yes*
42GR1697	CH	4520	2,475	-	-	-	+	-	Aeolian	Yes*
42GR1698	CH	4520	5,600	1 point 1 chopper 1 biface	-	-	+	-	-	Yes*
42GR1701	CH	4540	350	-	-	-	+	-	-	Yes*
42GR1702	CH	4480	5,525	-	-	-	+	-	-	Yes*
42GR1703	CH	4580	1,225	-	-	-	+	-	-	Yes*
42GR1704	CH	4550	375	1 biface	-	-	+	-	-	No
42GR1705	LS	4700	198	1 biface	-	-	-	1	-	No
42GR1706	CH	4640	5,700	1 point 1 hammer-stone 2 bifaces	-	-	+	1	-	Yes
42GR1707	CH	4680	900	1 point	1 metate	-	+	-	-	No

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1708	LS	4600	255	-	-	-	-	-	-	Yes
42GR1709	LS	4650	3,500	-	-	-	-	4	-	Yes
42GR1710	CG	4640	200	-	1 mano	-	-	1	-	No
42GR1711	LS	4680	8,250	-	-	-	-	2	-	No
42GR1712	CH	4680	10,000	-	-	-	+	12	-	Yes
42GR1713	LS	4640	750	-	-	-	-	-	-	No
42GR1714	LS/HC	4660	600	-	-	-	-	1	-	No
42GR1715	Q	4680	25,200	-	-	-	-	test cobbles	-	Yes
42GR1716	RS	4400	220	1 biface	-	-	-	5	-	No
42GR1717	CH	4480	3,150	-	-	-	+	-	-	Yes*
42GR1718	CH	4640	9,100	1 biface	-	-	+	-	-	Yes*
42GR1719	LS	4600	425	1 biface 1 hammerstone	-	-	-	1	-	Yes*

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APPENDIX 2. PREHISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Tools	Groundstone	Sherds	Hearth	Core	Dune Alluvial or Aeolian	N.R. status
42GR1720	LS	4660	1,500	1 point 1 biface	-	-	-	6	-	Yes
42GR1721	CH	4760	22,100	1 biface	-	-	+	-	-	Yes
42GR1722	Q/CH	4520	40 acres+	10 hammerstones	-	-	+	20	Aeolian	Yes
42GR1723	RS	4640	43,750	1 biface	1 mano	-	+	1	-	Yes
42GR1724	LS	4480	4,400	1 biface	-	-	-	-	-	Yes*
42GR1725	Q/CH	4480	18,000	2 points 6 bifaces	-	-	+	-	-	Yes*
42GR1732	CG	4620	8,500	3 bifaces 2 choppers 1 hammerstone	2 metates	-	-	-	Aeolian	Yes*
42GR1733	CH	4620	7,000	1 biface	-	-	-	+	Aeolian	Yes*
42GR1734	LS	4620	2,500	1 point	-	-	-	-		Yes*

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APPENDIX 3

HISTORIC SITE SUMMARY

APPENDIX 3. This section tabulates cultural features recorded at the 16 post-contact/historic sites. The following symbols are used to key sites, artifacts and features as follows:

SYMBOL	SITE TYPE	TOTAL
HC	Historic Campsite	4
HT	Historic Trash Scatter	2
HS	Historic Structure	2
MN	Mine	1
TC	Tin Can Scatter	2
RR	Railroad Station	1
RT	Railroad Trash Scatter	3
BS	Bead Scatter	1
TOTAL		16

SYMBOL	ARTIFACTS
B	Bottle
TC	Tin Cans
GL	Glass
WD	Wood
ME	Metal
NC	Common Nails
TCU	Tin Cup
BO	Bone
CS	Ceramics
LE	Leather
WI	Wire
AM	Ammunition
RB	Rubber

SYMBOL	FEATURES
HE	Hearth/campfire
MT	Mine tailings
DE	Depression
TR	Trail/Road
DU	Dump

APPENDIX 3. HISTORIC SITE SUMMARY

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Diagnostics	Historic feat. non-architectural	Historic architectural	Purple Glass	Hole-in top cans	Solder top condensed milk pre-1931	Other Debris	N.R. status
42GR1599	HC	5180	6,000	B, TC	-	-	+	-	+	GL,NC,WD	No
42GR1600	HC	5200	1,400	TC	HE	-	-	-	+	GL,WD	No
42GR1601	HC	5200	731	TC	HE	-	-	+	+	WD	No
42GR1602	HT	5280	1,600	TC	-	-	-	+	+	GL	No
42GR1621	MN	4640	1,350	TC	MT, DE(2)	loadout chute	-	-	-	WD,ME,NC,TC	No
42GR1640	TC	4760	100	TC	-	-	-	+	+	TC	No
42GR1641	TC	4740	110	TC	-	-	-	-	+	TCU	No
42GR1672	BS	4760	1,200	174 glass beads	-	-	-	-	-	-	Yes
42GR1674	HS	4577	1,500	B	-	2 sheds, log house, privy, corral, fence, well	+	-	-	WI, TC, WD, GL, ME, NC	Yes
42GR1677	RR	4490	190,000	B, TC	TR	2 privies, wooden support posts	+	-	-	GL,ME,NC,BO, CS,LE,WI,TC, AM,WD,RB	Yes

APPENDIX 3. HISTORIC SITE SUMMARY (CONTINUED)

Site Number	Site Type	Elevation (feet)	Site Size (m^2)	Diagnostics	Historic feat. non-architectural	Historic architectural	Purple Glass	Hole-in top cans	Solder top condensed milk pre-1931	Other Debris	N.R. status
42GR1678	RT	4440	7,700	B, TC	narrow guage railroad bed	-	-	-	+	GL,ME,NC,TC, AM,WD	Yes
42GR1679	RT	4460	1,400	B	-	-	-	-	-	GL,ME,NC,CS, WI,TC	No
42GR1699	HT	4530	250	B, TC	TR	-	+	-	-	GL,ME,CS,WI, TC	No
42GR1700	HS	4530	1,650	TC	DE,DU	foundation	-	-	+	GL,ME,NC,BO, CS,WI,TC,WD, RB	No
42GR1714	HC,LS	4660	600	TC	HE	-	+	-	+	AM,WD	No
42GR1726	RT	4380		B, TC	railroad grade	-	+	-	+	GL,CS,TC	Yes

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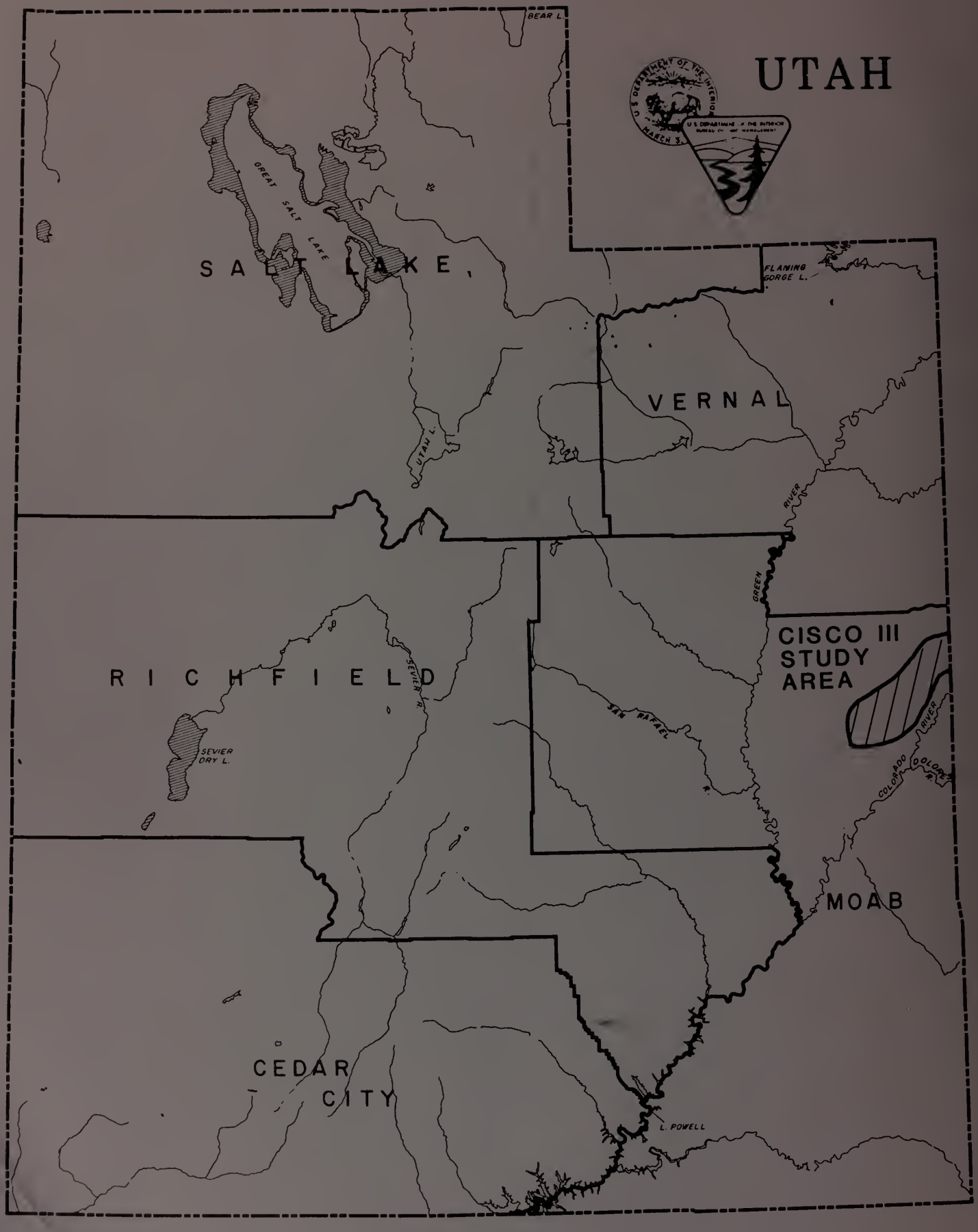
17 Gardiner F. Dalley and Douglas A. McFadden. *The Archaeology of the Red Cliffs Site.* (1985)

18 J.E. Bradley, W.R. Killam, G.R. Burns, M.A. Martorano. *An Archaeological Survey and Predictive Model of Selected Areas of Utah's Cisco Desert.* (1986)

19 K.D. Black and M.D. Metcalf. *The Castle Valley Archaeological Project: An Inventory and Predictive Model of Selected Tracts.* (1986)

20 B.A. Walling, R.A. Thompson, D.G. Weder. *Excavations at Quail Creek* With Ancillary Studies by K.M. Heath and L.W. Lindsay. (1986)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